

# THE OHIO JOURNAL OF SCIENCE

VOL. LIII

NOVEMBER, 1953

No. 6

## EARLY MAN IN EDEN VALLEY: A REVIEW

SIDNEY E. WHITE

*Department of Geology, The Ohio State University, Columbus 10*

Kirk Bryan once asserted that to evaluate properly the age of archaeological sites involving climatic changes due to glacial fluctuations, mutual cooperation of workers following several lines of endeavor was necessary. "Early Man in the Eden Valley" is such a collaboration. The strength of the dating of the Finley Site in Eden Valley lies in the meticulous research of John H. Moss, who, in joint publication with Kirk Bryan, G. William Holmes, Linton Satterthwaite, Jr., Henry P. Hansen, C. Bertrand Schultz and W. D. Frankforter, has produced an ideal combination of stratigraphy, glacial geology, geomorphology, archaeology, paleobotany, and vertebrate paleontology.

Published in 1951 by The University Museum of the University of Pennsylvania (Philadelphia, Penn., \$1.50) and edited by Loren C. Eiseley, this is the sixth in a series of Museum Monographs based on archaeological research. It is lithoprinted with left-hand margin control, measures  $8\frac{1}{4}" \times 10\frac{3}{4}"$ , and is attractively paper bound in blue. Errors, such as printing Moss' Figure 7 and Plate VI upside down, or too great reduction of some figures (Figs. 8, 12, 18) limiting legibility, will not detract from the complimentary attention this monograph should receive. Photographic reproductions and the panoramas illustrating Moss' paper are excellent. The monograph is dedicated appropriately to the memory of Edgar B. Howard, 1887-1943, and Kirk Bryan, 1888-1950, both pioneers in the study of Early Man in America.

The series of articles following Bryan's foreword (4 pp.), mistakenly titled "Forward," are entitled, "Glaciation in the Wind River Mountains and its Relation to Early Man in the Eden Valley, Wyoming" by Moss, 85 pp. incl. 9 pls. & 27 figs.; "The Regional Significance of the Pleistocene Deposits in the Eden Valley, Wyoming" by Holmes, 6 pp.; "The Temporal Association of The Artifacts with the Middle Sand" by Satterthwaite, 7 pp. incl. 3 figs.; "Pollen Analysis of Peat Sections from near the Finley Site, Wyoming" by Hansen, 6 pp. incl. 2 figs.; "A Preliminary Report on the Bison Remains from the Finley Site (Eden Bison Quarry)" by Schultz and Frankforter, 4 pp.

Always ready to systematize his thinking for his reader, Kirk Bryan arranges the problems of researchers concerned with the antiquity of Early Man into archaeological, chronological, and paleogeographical. Archaeological difficulties revolve around the meager number of artifacts collected to date, correlations based on typology, and the inadequate number of excavated sites. Geologic dating of sites by paleontologic and stratigraphic-geomorphic means involves certain inherent weaknesses—lack of a proved sequence of faunas from the beginning of the Pleistocene to the present. For the geologic method of attack to succeed, it is necessary to establish (in Bryan's words of 1940) that the cultural objects of the site are associated with a definite bed or beds, that these are related to some definite geologic event, that this event is related to other events or is of wide geographic extent, and that all can be correlated with some known worldwide geologic chronology. The difficulty in correlation with a worldwide glacio-

chronology is that glacial geologists are not at all agreed upon the glacial sequence of the Rocky Mountains and its correlation with that of the mid-North American continent and of Europe. Bryan calls attention to the weaknesses intrinsic in the great span of years indicated by his geologic methods in dating the deposits of the Lindenmeier Site in northern Colorado, those of the Sandia Cave east of Albuquerque, New Mexico, and the early deposits in the Ventana Cave west of Tuscon, Arizona. A complete anthropological understanding of the factual data accumulated by archaeological studies requires a paleogeographic approach.

The bulk of the monograph is a carefully written dissertation by Moss. He leads the reader through a mass of information gathered with premeditated and well-advised logic. His case for the geologic antiquity of the Eden-Yuma points of the Finley Site is presented with clarity and dispatch. His introduction is primarily for those not acquainted with the environment of Eden Valley, with a reiteration of the geologic method of dating archaeological sites, emphasizing the value of the date of 11,000 years as determined by radiocarbon dating for the Mankato substage of Wisconsin glaciation and the figure of 5,000 to 3,500 B.C. for the recent warmer, drier period, known by some as the Climatic Optimum and by others as the post-Wisconsin xerothermic interval.

Eden Valley is a shallow depression in the northeast corner of Bridger Basin, located in west-central Wyoming near the south end of the Wind River Mountains. Streams that flow southwest through Eden Valley to the Green River rise in the glaciated Wind River Mountains. The present cold arid climate of the Valley is extremely sensitive to minor climatic changes, and dry years weaken vegetation to such an extent that prevailing westerly winds move about the sand of the great Kilpecker Dune Field at the east edge of the Valley. The unpleasantness of such aridity suggests that the margins of the bison grazing ground of the Great Plains expanded into Eden Valley only during moister conditions of glaciation in the neighboring mountains. With the advent of glaciation came expansion of the grasses; the bison followed and so did Early Man. The discovery of bison bones in the dune sands of the Finley Site indicates the migration of bison in former moister periods into an area which is relatively arid today. The Finley Site may have been on one of the migration routes taken by Early Man from the Great Plains to the Great Basin.

A complex fluctuating eolian history for the eastern border of Eden Valley is recorded at the Finley Site by three superimposed windblown sands separated by two soil zones. The soil zones are shown to have climatic significance and are related to a sequence of glacial advances and retreats in the Wind River Mountains. The bison bones and Eden-Yuma points are associated with a definite bed—the Middle Sand.

Moss' greatest effort is expended in a careful account of the multiple glaciation that occurred in the southern Wind River Mountains. The earliest substages of glaciation represented by deeply weathered gravel or till patches, Moss correlates with Blackwelder's Buffalo advance. The next substage, Bull Lake I, consists of a dissected deeply stained moraine with a dissected outwash plain. Half a mile upstream, a slightly less dissected moraine with subdued topography comprises the Bull Lake II substage. Two to five miles farther upstream are the Pinedale I moraines with strong morainic topography, only slightly modified by erosion, and still farther upstream are the Pinedale II moraines also slightly modified by erosion. Up in the cirques, Moss finds sizeable moraine loops which have been designated the Temple Lake moraines. A few hundred feet in front of the present ice fields are small well-defined moraines, which Moss terms the Cirque moraines (his Neoglaciation).

The flight of terraces found in Big Sandy Creek valley fits neatly with episodes of glaciation in the mountains. High gravel-capped terraces are not traceable directly to any moraines, although the lower of two might have been formed during the Buffalo substage. The High Eden terrace and Low Eden terrace are traced

upstream to Bull Lake I and II substages, and the Upper Farson terrace and Lower Farson terrace are correlated with Pinedale I and II substages. Two lower terraces, Parker terrace and the Floodplain terrace are the equivalent of the Temple Lake Readvance and the Neoglaciation. Photographs used in illustration depict the flight of terraces superbly.

The sands at the Finley Site all overlie gravel of the Upper Farson terrace and are younger than Pinedale I. The Lower Sand at the Site was deposited during the drier time between Pinedale I and Pinedale II. A soil was developed on it during the cold, wet period of Pinedale II advance. The Middle Sand was deposited during the dry interval between Pinedale II and the Temple Lake substage. During the moderately wet period of the Temple Lake substage, Eden Valley became grass-covered, and the bison bones and Eden-Yuma points were introduced. According to Moss, Early Man was present during the Cochrane substage of Wisconsin glaciation. The time when Early Man lived in Eden Valley is estimated by Moss to be approximately 7,000–9,000 years ago. This date was determined by geologic means in 1948 and was presented in a doctoral dissertation in May, 1949. A radiocarbon date for bison bones from Sage Creek, near Cody, Wyoming, Yuma Site of Eiseley and Jepsen (now called Horner Site) of an average age of  $6,876 \pm 250$  years (Sample 302, Arnold and Libby, 1951, p.118) closely approaches Moss' estimate. It seems that this work of Moss somewhat vindicates Kirk Bryan's geologic method of dating archaeological sites.

Moss still adheres to the division of the Wisconsin, following the practice of Kirk Bryan, wherein it is divided into the Iowan (W1), Tazewell-Cary (W2), and Mankato (W3), with a minor later refrigeration, the Cochrane (W4). Moss correlates the Buffalo advance with the Iowan, Bull Lake I and II substages with Tazewell-Cary, Pinedale I and II with Mankato, Temple Lake Readvance with Cochrane, and his Neoglaciation with Matthes' Little Ice Age. The tendency in the past has been to parallel the European threefold division of the Würm, but a wealth of facts is accumulating which points to division of the Wisconsin in North America into at least four substages, the first two, Iowan (W1) and Tazewell (W2), separated by a major time break from the Cary (W3) and Mankato (W4). In 1947, Flint established these as the four Wisconsin substages, emphasized the shortness of the interval between the Iowan and Tazewell (1947, p.249), and inferred that the Two Creeks interval between the Cary and Mankato also was short (1947, p.252). Support in favor of greater duration for the Tazewell-Cary interval comes from other sources. The persistent work of John C. Frye, A. Byron Leonard, Ada Swineford, and others, on soils and stratigraphy of loesses in Kansas indicates that the Tazewell-Cary interval was a major time break in the Wisconsin (Frye, 1951, p.406; Frye and Leonard, 1951, p.302; Leonard, 1951, p.325). Evidence of a great length of time between Tazewell and Cary is shown in topographic discontinuities where study is made of stream drainage patterns. Analysis of drift topographies by Robert V. Ruhe show that Iowan and Tazewell drifts are closely related in time, and that drainage patterns of Cary and Mankato drifts are so similar to each other that these, too, are closely connected in time (Ruhe, 1950, p.441; 1952, pp.49–50).

Holmes has provided a compendium regarding the present status of Wisconsin glaciation in the Middle Rocky Mountain area. The substages described are similar to those found by Moss: a Buffalo substage which may represent two very old substages, a compound Bull Lake substage, a compound Pinedale substage, a Temple Lake substage, and a Little Ice Age—all of which substantiate the multiple sequence of deposits in Eden Valley.

Satterthwaite describes the dune deposits of the Finley Site and the positions of 17 Eden-Yuma points found in 1940 and 1941. Much reliance is placed upon other papers for information that might have been reproduced profitably for readers of the monograph. The points regrettably are not described, their typology not discussed, nor are they pictured, save for Figure 1 of Plate I of Moss' paper.

Information regarding the positions of the points is discouraging, for some were not observed first in place, some were discovered later on a refuse pile or after heavy rains, some are undoubted inclusions, and some were moved by or introduced by rodents. On the other hand, there seems to be no doubt that the points belong "in time with the bison bones on the Middle Sand Horizon."

Hansen established two pollen profiles from a swamp in Washington Draw, one-quarter mile northwest of the Site. The sand in the swamp bottom is stratigraphically equivalent to the lowest dune sand at the Site. The profiles represent the accumulation of debris and pollen since Pinedale I. The fir pollen indicate merely a warming up throughout the profiles. The spruce pollen are so poorly represented that little trend is shown, although at least three maxima can be seen in the three meter deep profile. Hansen places greatest significance upon the expansion of grasses, which was greater in the past than now. Throughout the Pacific Northwest, the grass maximum came early in the post-Wisconsin xerothermic interval, and is dated between 8,000 and 4,000 years ago. In the Bridger Basin, Wyoming, Hansen puts the grass maximum earlier, from 10,000 to 8,000 years ago, and perhaps contemporaneous with the Temple Lake substage. The grass maximum and the associated available water attracted both bison and Early Man.

Of vertebrate remains, only bison bones were found at the Site—those of at least 48 individuals. They were brought to the Site by hunters in numerous trips. The bones are similar to those found at Scottsbluff Bison Quarry and Lipscomb Bison Quarry. Schultz and Frankforter suggest that the specimens can be referred tentatively to *Bison occidentalis* Lucas.

With the exception of Satterthwaite's paper, the six articles in the monograph were written as independent units. Satterthwaite's is dependent upon its inclusion in the monograph and his descriptions are well integrated with Moss' stratigraphy and terminology. Schultz and Frankforter do not mention the work of any of the others. Hansen refers to Moss once. Holmes interrelates Moss' work on glaciation with that of others throughout the Middle Rocky Mountain area. Moss appropriately renders an account of the work of each of the others whenever it becomes necessary to discuss their efforts and to weave the various phases into a complete story. Field work on the archaeology and vertebrate paleontology was accomplished before World War II, whereas the glacial geology, geomorphology, and paleobotany were not begun until afterwards. With the exception of Moss and Holmes, none of the other specialists were in the field together at the same time (John H. Moss. Written communication, January, 1952), and as a result the monograph suffers somewhat from lack of necessary field discussions, and hence from integration.

Publication of all the aspects of a Pleistocene problem in one volume furnishes a unity that individually published papers cannot achieve. The writers and editor of this monograph are to be commended for their joint production and in bringing into one place the ideas and efforts of seven specialists. It is hoped the dating of other archaeologic sites the world over may be fulfilled by similar collaboration.

#### REFERENCES

- Arnold, J. R., and W. F. Libby. 1951. Radiocarbon dates. *Science*, 113: 111-120.  
Flint, R. F. 1947. Glacial geology and the Pleistocene epoch. John Wiley & Sons, Inc., New York.  
Frye, J. C. 1951. Soil-forming intervals evidenced in the Kansas Pleistocene. *Soil Sci.*, 71: 403-408.  
———, and A. B. Leonard. 1951. Stratigraphy of the late Pleistocene loesses of Kansas. *Jour. Geol.*, 59: 287-305.  
Leonard, A. B. 1951. Stratigraphic zonation of the Peoria loess in Kansas. *Jour. Geol.*, 59: 323-332.  
Ruhe, R. V. 1950. Graphic analysis of drift topographies. *Amer. Jour. Sci.*, 248: 435-443.  
——— 1952. Topographic discontinuities of the Des Moines Lobe. *Amer. Jour. Sci.*, 250: 46-56.

# THE OHIO CAVE SURVEY

PHILIP M. SMITH

*The National Speleological Society, Washington, D. C.*

A perusal of the literature on the limestone caves of Ohio indicates a decided absence of information in this area. White (1926) in his study of Ohio caves provided a sketchy knowledge of some twenty caves. Shetrone (1928) has treated briefly the archaeological importance of some of these caves, and Cottingham (1919) discussed the formation of the South Bass Island caves. Hills (1916) described Reames Cave (Ohio Caverns). Smith (1953) recently discussed Ohio caves in their relationship to cave conservation. Little else of a serious nature has been reported.

In 1952, the Central Ohio Grotto of the National Speleological Society in cooperation with the Ohio Geological Survey established a comprehensive survey of the Ohio caves and caverns. The work of this study includes a general description of the caves, their locations, and a discussion of the geological features of the caves. Maps after the standards adopted by Davies (1947, 1949, 1950) are being made. Further, a photographic study of each cave is made. This includes not only black and white pictures, but also kodachrome transparencies. Historical anecdotes related to the caves are noted. Also a study of cave fauna is being carried out in cooperation with the natural history section of the Ohio Archaeological and Historical Society. Relationships have also been established with the Cleveland Grotto of the National Speleological Society and the Ohio Division of Wildlife. It is hoped that the end result of this survey will be the publication of a definitive volume on Ohio caves.

To implement the survey program, the Geological Survey addressed letters describing the project and the need for cave locations to county engineers, county agricultural agents, and historical societies throughout the state. From the reply to this letter and from the work of the survey investigators, a preliminary list of more than one hundred caves has been compiled. Most of these listings are in limestone areas and will receive the major attention of the report. A few sandstone overhangs and rock shelters such as those in the Hocking area may be included because of their widespread fame.

Intensive study has been carried out in more than twenty caves. Preliminary maps and geological notes have been completed in fourteen cases.

From the fieldwork done in the first year of the survey several problems have arisen, all of which bear further study. These include:

- 1) The general theory of formation of Ohio caves. Some of the caves, at least, are formed in a manner quite different from the usual solution processes. Cottingham (1919) and White (1926) have pointed out the singular features of the South Bass Island caves. Verber and Stansbery (1953) have attacked this problem. More study is needed in other areas.

- 2) The relationship between cave formation and the glacial boundary, and the relationship between cave fauna and the boundary. Exploration has provided an interesting pattern of caves close to the glacial boundary in at least one southern Ohio county. The cricket (*Ceuthophilus gracilipes*) normally found in non-glaciated areas has been collected north of the Illinoian boundary.

- 3) The migration of salamanders into and out of certain caves. The ecological aspects of a cave environment are known to have marked effects on animal movements. Work in this area could contribute to our concepts here.

- 4) The possibilities of both paleontological and archaeological remains in some caves. Careful study could yield much informative material in these areas. Work in some caves will begin soon.

5) The occurrence of the Eastern Big-eared Bat (*Corynorhinus macrotis macrotis*) in Ohio. The first report of this bat has raised speculation as to the range of the Eastern Big-eared Bat. This problem is under study at the Ohio State Museum and at the National Museum.

It is hoped that others will be able to contribute to the study of Ohio caves. Information on cave locations is always welcome. Cooperative studies in some phase of the project could speed the completion of the work. All communications regarding the cave survey should be addressed to the Ohio Geological Survey office, Orton Hall, the Ohio State University, Columbus 10, Ohio.

#### LITERATURE CITED

- Cottingham, K. 1919. Origin of the caves at Put-in-Bay, Ohio. *Ohio Jour. Sci.*, 20: 38-47.  
 Davies, W. 1947. Cave maps and mapping. *Nat. Speleo. Soc. Bull.* 9: 1-7.  
 ———. 1949. Caverns of West Virginia. *W. Va. Geo. Surv. Bull.* 19: 49.  
 ———. 1950. The caves of Maryland. *Bull. Dept. Geo. Mines and Water* 7: 15-16.  
 Hills, T. 1916. Reames cave. *Ohio Jour. Sci.*, 16: 206-215.  
 Shetrone, H. C. 1928. Some Ohio caves and rock shelters bearing evidence of human occupancy. *Ohio Arch. Hist. Soc. Quart.* 37: 1-34.  
 Smith, P. M. 1953. Let's save Ohio's caves. *Ohio Cons. Bull.* 17: 6-7, 31.  
 Verber, J. L., and D. H. Stansbery. 1953. Caves in the Lake Erie Islands. *Ohio Jour. Sci.*, 53: 358-362.  
 White, G. 1926. The limestone caves and caverns of Ohio. *Ohio Jour. Sci.*, 26: 73-116.

---

**Design for a Brain.** W. Ross Ashby. John Wiley & Sons, Inc., New York, 1952. ix+260 pp. \$6.00.

This is an unusual book both as to form and content.

The main paragraphs of each chapter are numbered and the illustrations are numbered according to the chapter and paragraph to which they relate. This arrangement facilitates the use of cross references since each page bears, in addition to the page number, the chapter and paragraph number.

The content of the book may be roughly divided into what the author terms the "non-mathematical" chapters and the Appendix which contains the appropriate mathematical formulations.

This is a treatise in bio-mathematics and it appears to be addressed to a small audience. This reviewer certainly lacks the ability to comprehend the mathematical angles of the presentation and it is probable that other biologists will have similar difficulties. On the other hand, mathematicians may have some difficulty understanding the references to anatomy and physiology.

The author attempts to explain how the nervous system can produce learned behavior that is adaptive. A form of behavior is said to be adaptive when its essential variables are kept within physiological limits. Changes in the environment tend to push these variables beyond physiological limits but the adaptation mechanisms of the organism tend to keep the variables within these limits and thus to bring about a condition of stability. The latter term does not imply a fixed state or a condition of rigidity but rather one of control within a range of action. Such control involves the concept of feed-back which means that as behavior is being accomplished information is fed back into the nervous system from the active muscles or glands to yield information in terms of error in approach to goal. The brain is held to be an ultrastable system which acts selectively towards its main variables, rejecting changes that would lead to critical points in adjustment ranges, and retaining these changes which do not. Thus, the brain can produce adaptive behavior.

DWIGHT M. PALMER.

# AN ANNOTATED LIST OF OHIO MOSQUITOES

CARL E. VENARD AND FRANK W. MEAD<sup>1</sup>

*Department of Zoology and Entomology, The Ohio State University, Columbus 10*

In 1906 Burgess published a list of 17 species of mosquitoes for the state of Ohio. This report was based on some collections he made during the summer of 1905 and on specimens supplied by Profs. H. Osborn and J. S. Hine. Dr. L. O. Howard furnished a record of *Wyeomyia smithii* and W. E. Evans, who did considerable collecting in the preparation of an undergraduate thesis for the B.Sc. at The Ohio State University, furnished some data.

The Reference Collection of Insects of this department today contains a number of specimens which were studied by Burgess. The undergraduate thesis by Evans (1906) contains the list compiled by Burgess and information which is useful in interpreting the list. The 17 names given by Burgess includes two, *Megarhinus portoricensis* Roeder and *Toxorhynchites rutilus* Coq., which refer to the species now known as *Toxorhynchites rutilus septentrionalis* (Dyar and Knab). Another name, *Anopheles maculipennis* Meigen, was used for specimens collected at Sandusky, all of which in the museum at the present time are *A. walkeri* Theobald.

Hoyt and Worden (1935), in studying a small epidemic of malaria at Aurora, Ohio, reported *Anopheles punctipennis* and *Anopheles quadrimaculatus*.

Articles by Jenkins and Carpenter (1946) and Sharkey (1946) contain some Ohio records on tree-hole-breeding species and anophelines, respectively, which the senior author furnished.

Starting in 1946, with the establishment of the Toledo Area Sanitary District mosquito control program, Crandell has included in his annual report the names of mosquitoes found and identified by that organization. The five reports for 1946-1950 contain a total of 43 names of species of mosquitoes collected in that locality. It should be emphasized that a number of the identifications were tentative. Species named in these reports and not found or seen by us are: *Anopheles occidentalis*, *Anopheles pseudopunctipennis*, *Aedes alleni*, *Aedes communis*, *Aedes impiger*, *Aedes infirmatus*, *Aedes intrudens*, *Aedes pionips*, *Aedes punctor*, *Aedes spencerii*, *Culex stigmatosoma*, *Culex tarsalis*, *Culiseta impatiens*, *Culiseta incidens*, and *Orthopodomyia alba*.

Masters (1949) made a study during 1946-1948 of the adult mosquito population in a Cuyahoga County woods where he found 21 species.

Mead (1949) presented, for the M.Sc. thesis requirements at The Ohio State University, a study of mosquitoes of Central Ohio which contains much data on the seasonal and ecological distribution of 34 species. He included data on *Aedes impiger* and *Aedes intrudens*, but has decided that these identifications based on larvae and females respectively, should not be accepted.

In 1940 the senior author made his first collection of mosquitoes in Ohio, and has collected some every year since then; and for the past five years the junior author has been active in this program. Although we have made collections in 83 of Ohio's 88 counties, there are still large areas to be studied. Also, the areas more distant from Columbus have been visited only occasionally. Our studies have been made incidentally to our regular duties; much material remains to be examined. Therefore, this report is a preliminary one.

The collections were made by dipping larvae and, in some instances, rearing them to the adult stage; capturing biting females; taking resting adults from

<sup>1</sup>Present address: United States Department of Agriculture, Agricultural Research Administration, Bureau of Entomology and Plant Quarantine.

buildings or natural resting places; and by sweeping vegetation for adults. Identifications, except where otherwise indicated, are based on fourth-instar larvae or males, or both, in addition to adult females. All comments for the various species are based on our observations in Ohio.

Dr. Edward S. Thomas of the Ohio State Museum, Dr. William C. Stehr of Ohio University, and Prof. Josef N. Knull of The Ohio State University have kindly furnished us with records from their collections. Dr. Herbert A. Crandell enabled us to study specimens collected by the Toledo Area Sanitary District and furnished laboratory facilities for examining the specimens. Doctors John M. Hutzel, John B. Gerberich, Howard W. Smith, Robert L. Bickle, Louis M. Roth, and Mr. Robert L. Goulding have all been helpful in making collections and identifications. We appreciate the assistance received from all of these people. Two grants to the senior author from the Research Fund of the Ohio Academy of Science partially met traveling expenses for two summers.

#### LIST OF SPECIES

1. *Anopheles barberi* Coquillett. Although this tree-hole-breeding species is probably generally distributed throughout Ohio, it has been collected in less than a dozen localities and may be regarded as fairly rare and unimportant.

2. *Anopheles crucians* Wiedemann. Ohio constitutes a section of the northern limits in the range of this pest species. In Ohio, *A. crucians* is rare, but in one locality, Indian Lake, it was present in sufficient numbers during autumn to be considered a nuisance. Larvae were usually found in cat-tail marshes, but on one occasion they were found along a drying stream.

3. *Anopheles punctipennis* (Say). This is our most abundant and widely distributed anopheline, but it is not usually a serious pest. It is found in a great variety of habitats, both inside and outside of cities, and often enters homes.

4. *Anopheles quadrimaculatus* Say. The famous vector of malaria is the second most abundant and generally distributed anopheline in Ohio. Small farm ponds, which are becoming very numerous, and reservoirs used for city water supplies or resort areas, are the usual breeding places.

5. *Anopheles walkeri* Theobald. This anopheline has been found in several widely separated portions of the state. Although it is sometimes quite abundant and annoying in local situations such as at Indian Lake and Lake Erie, it probably should have the ranking of a rare mosquito. The largest populations occur in cat-tail marshes.

6. *Aedes aurifer* (Coquillett). This mosquito seems to be in the southern part of its range in Ohio. It is usually rare, but when the females are encountered, they press a fierce attack. Captures have so far been restricted to woodland situations in Fairfield, Logan, and Hardin counties.

7. *Aedes canadensis* (Theobald). One of the most important earlybreeding pest mosquitoes in the state is *A. canadensis*. It is both widely distributed and very abundant. Its habitat is primarily in the forests, but the larvae are often found in other places such as roadside ditches and marshy areas.

8. *Aedes cinereus* Meigen. So far, *A. cinereus* has been collected only in the northern half of the state. The females can be energetic biters, but the species seems to be unimportant because of its rarity. The larvae have been found in small pools in and about forests and marshes.

9. *Aedes dorsalis* (Meigen). One larva was collected in Wayne Co., and adults have been collected in Lucas Co. by the Toledo Area Sanitary District, and in Lake Co. by the writers. Industrial wastes seem to be an important factor in providing a suitable habitat, and in Ohio this species must be considered rare.

10. *Aedes excrucians* (Walker). This is another one of the earlybreeding woodland mosquitoes whose range extends southward from Canada to the northern

half of Ohio. Since this species is rare, it does not matter much to Ohioans that the females are fierce biters.

11. *Aedes fitchii* (Felt and Young). *Aedes fitchii* is similar to *A. excrucians* in most respects, including its rareness. It has been taken in eight counties.

12. *Aedes grossbecki* Dyar and Knab. One of the most surprising discoveries to the writers was the many times this species was collected. However, the adults were seldom taken in the numbers expected in relation to the number of larvae observed. Practically all of the findings were in the northern two-thirds of the state, and the northwest quarter in particular.

13. *Aedes implacabilis* (Walker). The only record at hand is one larva collected by the writers in Portage County at a buttonbush swamp.

14. *Aedes sollicitans* (Walker). Although several salty water areas have been investigated, only one area has so far been discovered where *A. sollicitans* was present. This was in Lake County where, on occasions, the females were so abundant and fierce that life was miserable in the immediate vicinity.

15. *Aedes sticticus* (Meigen). Our experience is that this species attains its greatest abundance in northwestern Ohio. It is often the most important pest in this area during early summer. Elsewhere in the State it is not usually so abundant, indeed, it is absent or scarce in many areas even where it might be expected. *Sticticus* breeds in woodland pools, marshes, and floodwater situations.

16. *Aedes stimulans* (Walker). The Brown Woods Mosquito is an early breeding species that is widespread throughout most of the state, particularly in the more level areas. It is probably the most important early-season pest in the more northern forested areas.

17. *Aedes thibaulti* Dyar and Knab. Ohio may be a part of the northern or northeastern extreme in the range of this tree-hole-breeding species. Females were found in Cuyahoga County by Masters, and in Fairfield County by the writers. The females are fierce biters.

18. *Aedes tormentor* Dyar and Knab. Larvae have been collected in Franklin County, and biting females of what are probably this species have been taken in two other woodland localities in Fairfield and Perry counties. This is another southern species that is at the northern limits of its range in Ohio.

19. *Aedes triseriatus* (Say). This is the most widespread and common tree-hole-breeding species in Ohio. Although *A. triseriatus* is not usually present in large numbers like *Aedes stimulans*, for example, it is active for a long season and must be considered a major pest. Unlike *A. stimulans*, it is occasionally a pest around homes in cities.

20. *Aedes trivittatus* (Coquillett). Collections of this common and important species have been made in counties scattered all over Ohio. The larvae are found in temporary pools in a variety of habitats. The adults are found in both woods and lightly shaded rural areas, will bite in bright sunlight, and from mid-July until frost they are a serious pest, but fortunately do not migrate nearly as much as *A. vexans*.

21. *Aedes vexans* (Meigen). All things considered, this is probably the worst pest species in Ohio. It breeds in a wide variety of habitats both wild and domestic. Its distribution appears to extend throughout the State. It is the experience of the writers that most mosquito complaints during late summer and early autumn are attributable to *A. vexans*.

22. *Culex apicalis* Adams. Even though this species is common and widely distributed over the state, it is of no importance as a pest since the females are not known to feed on man. Our material reported under this name agrees with the description for *Culex territans* Walker and not with the description of *Culex apicalis* Adams as given by Bohart (1948).

23. *Culex erraticus* (Dyar and Knab). The writers have collected *C. erraticus* only a few times, and they consider it rare. The larvae appear in summer and

are usually found in quiet ponds with considerable vegetation. The females are not considered troublesome.

24. *Culex pipiens* Linnaeus. This is the common house mosquito, and it well deserves its title. However, the writers have not observed females of Ohio specimens taking blood meals. The distribution of *C. pipiens* is very wide not only as to geography, but also as to season and habitat. *C. quinquefasciatus* Say was reported for Cincinnati by Dyar (1922), but the writers have not made any attempt to recognize this species in Ohio.

25. *Culex restuans* Theobald. *C. restuans* is very common in woodland pools, bogs, and domestic situations. Its geographical and seasonal distribution is similar to that of *C. pipiens* except that the larvae are found earlier in the spring and later in the fall.

26. *Culex salinarius* Coquillett. On the basis of existing records in Ohio, this mosquito should be considered uncommon to rare even though the distribution could be fairly widespread. The larvae have been found primarily in domestic situations. The females apparently cause very little trouble as a pest.

27. *Culiseta inornata* (Williston). Collections are insufficient to allow much generalizing on the distribution of this species, but it can probably be found widely scattered throughout the State. Marshy areas constitute the principal habitat, but artificial conditions such as abandoned wells are sometimes utilized. The females seldom cause trouble even though they are said to use houses as resting places.

28. *Culiseta melanura* (Coquillett). This species seems to be quite rare since it was found at only two places, the cranberry-sphagnum bog at Buckeye Lake in Licking County and a bog in Ashland County.

29. *Culiseta moristans* (Theobald). *C. moristans* has been found only a very few times and these records were obtained in the northern part of the State. It is a bog-inhabiting species.

30. *Psorophora ciliata* (Fabricius). Collections of this large mosquito have been made in counties scattered all over the State. *P. ciliata* is versatile in its biting habits in that it will attack both in forested and cleared areas, and it will settle down on a moving person. The species is fairly common although it seldom attacks in swarms.

31. *Psorophora confinnis* (Lynch Arribláza). The famous rice-field mosquito of the South seems to be rare in Ohio, but the existing records are by no means restricted to the southern counties because most of the collections are from central and northwestern Ohio.

32. *Psorophora cyanescens* (Coquillett). Very little is known about this rare species in Ohio. A biting female has been collected in Licking County.

33. *Psorophora discolor* (Coquillett). Several specimens were found in Franklin County by John M. Hutzler in 1942 and a single female which remains appears to be the only record for the State thus far.

34. *Psorophora ferox* (Humboldt). This species is generally distributed over the State and perhaps it is the most common and obnoxious member of its genus in Ohio. It breeds in temporary pools, usually with *Aedes trivittatus*, and it stays close to woodland areas.

35. *Psorophora horrida* (Dyar and Knab). It may be that *P. horrida* is distributed over the major part of Ohio but due to its being uncommon, not enough records have been obtained to make an accurate statement of its distribution. When encountered, the females are fierce biters.

36. *Psorophora varipes* (Coquillett). Biting females have been obtained from three woodland areas in Fairfield, Franklin, and Logan counties. Dr. M. R. Newkirk has collected this species in Ashland County. Apparently *P. varipes* is one of the more rare species in the State.

37. *Mansonia perturbans* (Walker). *Mansonia*, widely distributed over the State, is a pest of major importance in the larger marshes such as those at Indian Lake and Lake Erie.

38. *Orthopodomyia signifera* (Coquillett). This tree-hole-breeding species can probably be found in most sections of Ohio, but it is of little economic importance because the females do not bite man. It is not nearly as abundant as the most common tree-hole-breeding species, *Aedes triseriatus*.

39. *Wyeomyia smithii* (Coquillett). Pitcher plants (*Sarracenia*) have been investigated in several localities, but usually with negative results. In addition to the record by Howard reported by Burgess, the only other positive records of this species are those of E. S. Thomas. He collected *Wyeomyia* in Ashland, Stark, and Wayne Counties.

40. *Uranotaenia sapphirina* (Osten Sacken). A moderately common, very small mosquito that apparently does not bite and that breeds over most of Ohio in clean water of permanent-type ponds.

41. *Toxorhynchites rutilus septentrionalis* (Dyar and Knab). This nonbiting, rare, tree-hole-breeding mosquito does not seem to be restricted to any one part of Ohio.

#### REFERENCES

- Abdel-Malek, A. 1948. The biology of *Aedes trivittatus*. Jour. Econ. Ent., 41: 951-954.  
 Bohart, R. M. 1948. The subgenus *Neoculex* in America North of Mexico. Annals Ent. Soc. Amer., 41: 330-345.  
 Burgess, A. F. 1906. A preliminary report of the mosquitoes of Ohio. Ohio Naturalist, 6: 438-440.  
 Crandell, H. A. 1946-1951. Five mimeographed reports for 1946, 1947, 1948, 1949, 1950 of the mosquito control program of the Toledo Area Sanitary District, 5015 Stickney Avenue, Toledo 12, Ohio.  
 Dyar, H. G. 1922. The mosquitoes of the United States. Proc. U. S. Nat. Mus., 62: 1-119.  
 Evans, Jr., W. E. 1906. The mosquitoes of Ohio. B.S. Thesis, The Ohio State University, Columbus.  
 Goulding, R. L. 1948. A study of some food organisms of several species of mosquito larvae and some of the larva-organism relationships involved. M.Sc. Thesis, The Ohio State University, Columbus.  
 Hoyt, R. N., and R. D. Worden. 1935. Malaria epidemic in Aurora, Ohio. Public Health Reports, Wash., 50: 895-897.  
 Jenkins, D. W., and S. J. Carpenter. 1946. Ecology of the tree-hole breeding mosquitoes of Nearctic North America. Ecolog. Monog., 16: 31-48.  
 Masters, C. O. 1949. A study of the adult mosquito population of a Northern Ohio woods. Ohio Jour. Sci., 49: 12-14.  
 Mead, F. W. 1949. Ecology of Central Ohio mosquitoes. M.Sc. Thesis, The Ohio State University, Columbus.  
 Sharkey, T. P. 1946. The management of malaria. Ohio State Med. Jour., 42: 1025-1034.

---

**Developmental Plant Anatomy.** Richard A. Popham. Long's College Book Co., Columbus, Ohio. 1952. xix+181 pp. mimeotyped in loose-leaf binder. \$4.50.

For the first time we have a laboratory sequence of studies in plant anatomy that is arranged in such a way that by the end of the course the students have a picture of how and where a plant grows. The work is a guide to the origins of tissues and organs that will give students the foundation for further studies and the summaries of the literature will be invaluable to both students and teachers.

The author rightly suggests that this is a plant anatomy for all phases of applied botany. It is also well organized for the teachers who will teach beginning courses as well as for the morphologist, physiologist, pathologist, and ecologist. Although this sequence of studies is quite a departure from those usually followed, the teachers who use this plan can report that students respond with a real interest. It is a workbook for a class taught by a teacher who has had training in plant anatomy, physiology and ecology. It is refreshing that phylogeny and the history of plant anatomy are not a part of the book.

ERNEST L. STOVER.

## THE CABBAGE ROOT APHID

GEORGE P. WENE AND A. N. WHITE

*Texas Agricultural Experiment Station and Texas Agricultural Extension Service, Weslaco*

The cabbage root aphid, *Pemphigus populitransversus* Riley<sup>1</sup> was found in destructive numbers in practically all cabbage fields in the Lower Rio Grande Valley of Texas during the winter months of 1951-52. The activity of this insect has been observed since 1947 in stunting a few plants, but never causing enough damage to consider it a pest. The 1951-52 cabbage crop was grown under severe drouth conditions, which was accentuated by the lack of irrigation water from the Rio Grande River. The cabbage root aphid was first noticed in fields which were suffering from a lack of irrigation water.

Hull (1929) called this aphid the turnip root louse and stated that this aphid increased or exaggerated the injury caused by the turnip aphid, *Rhopalosiphum pseudobrassicae* (Davis), to turnips. He stated that the cottonwood tree was the summer host of the turnip root louse. Gillette and Bragg (1915) listed *Populus* as the winter host and stated that the alternate host is unknown. It is significant to record that on March 25, 1952, which is usually the end of the cabbage season, a farmer collected a large number of the winged forms of *populitransversus*, from the base of a cottonwood tree at Harlingen, Texas.

Cabbage root aphids were first found in large numbers, 25 or more per square inch of soil surface, when the heads of cabbage were at least 2 inches in diameter. These aphids were found feeding on the secondary and adventitious roots to a depth of 8 inches in rather dry soil. After the adventitious roots and secondary roots had been destroyed, the aphids were found feeding on the tap root. With the destruction of the secondary and adventitious roots, the plants became stunted and yellowish in color. Heavy root aphid infested plants, in a well watered field, could be detected on a hot dry day by the fact that severely infested plants would have a wilted appearance, as if suffering from a lack of water. Such severely infested plants seldom produced a marketable head even when sufficient water was applied during the remainder of the growing season.

In the Lower Rio Grande Valley, cabbage fields are tilled in such a manner as to have raised beds about 36 inches apart. These beds are from 8 to 12 inches high with the cabbage planted on top. In irrigating the fields, the water is diverted in the depression between the beds at such a rate that the water is almost as high as the beds. It was observed that such irrigations washed out a great number of cabbage root aphids. Furthermore, during the irrigation process the cabbage root aphids were seen migrating to the surface of the soil, on top of the plant bed, apparently in order to escape the water. Two or three days after an irrigation and while the soil was still saturated with water, aphids were still found on the surface of soil, usually under dead leaves or other organic matter lying on the soil surface. Numerous digging observations indicated that the aphids migrated to depths of 3 to 5 inches only when the soil had become fairly dry. The few cabbage fields which were irrigated at 7 to 10 day intervals produced good yields of cabbage in spite of root aphid infestations. However, irrigations were of little value in one field when the water applications were started after a severe infestation had already been established. Hawley (1925) stated that the sugar-beet root aphid, *Pemphigus betae* Doane, can be controlled by practicing early and frequent irrigations. He further stated that the sugar-beet root aphid

<sup>1</sup>Identified by L. M. Russell, Bureau of Entomology and Plant Quarantine, U. S. D. A.

does not thrive well under moist conditions, and apparently the cabbage root aphid is similar in this respect as shown by the fact that cabbage was produced in well irrigated fields in spite of heavy aphid infestations, and also that the heaviest aphid infestations were found in fields which were suffering from a lack of irrigation water.

In three fields of well irrigated cabbage, numerous Dipterous pupae were found at a depth of approximately one inch from the surface of the soil. Forty pupae were found in a cubic inch of soil. Further examinations showed a number of larvae feeding on the cabbage root aphids. Adults were reared from these larvae and pupae and were identified as *Thaumatomyia apacha* Sabr.<sup>2</sup> A survey revealed that these predatory insects were abundant only in well irrigated fields. Observations taken on December 15, 1951, showed that the cabbage root aphid was very abundant in a field near Pharr. On January 15, 1952 very few aphids were found on the cabbage roots in spite of the fact that the roots were covered with the white downy-like material which is associated with cabbage root aphids. However, numerous larvae and pupae of the predator were found, which indicated that the predator was a factor in the reduction of the root aphid population. Parker (1918) showed that *Thaumatomyia glabra* Meig., a closely related predator, is an important biological enemy of the sugar-beet root louse (whose life history is similar to that of the cabbage root aphid).

An attempt was made to control the cabbage root aphid by the addition of insecticides to the irrigation water. The field in which the experiment was conducted was of such a length that 10 rows of cabbage were an acre in size. The head of water in the irrigation ditch was of such a size that 10 rows could be irrigated at the same time in a period of one hour. The insecticide, in an emulsion form, was added to a 50 gallon drum of water, and then allowed to drip into the irrigation ditch at such a rate that the drum would be emptied at the same time that the plot had sufficient water. Single plots were treated, at the following acre rate, with: 1-pound of parathion; 1-pound of gamma benzene hexachloride; 1-quart of 40 percent TEPP; and water alone. A week after the treatment applications, soil samples were taken near 12 plants in each plot. A hand trowel was used in digging out a large lump of soil adjacent to the tap root of the cabbage plant. This lump of soil was then broken in 4 or 5 pieces, and the aphids counted on a square inch of surface from one of the pieces having the largest population. The treatments showed the following average number of aphids per square inch of surface: 1-pound of parathion, 5.2; 1-pound gamma benzene hexachloride, 6.2; 1-quart 40 percent TEPP, 7; and 10.7 for plot which was treated with water. The data indicate that the control obtained was not sufficient to be of any practical value.

In the second experiment, 4 plots each 10 feet long and 6 feet wide were laid out in a field of cabbage. Fifty gallons of water were added to the first plot. The remaining plots received the same amount of water but emulsifiable Metacide was added at the rate of 1, 2, and 4 pounds per acre. Three days after the treatment applications, 20 soil samples were taken from each plot and the number of surviving aphids determined. The treatments showed the following number of aphids per square inch of soil surface: 1-pound Metacide, 5.1; 2-pounds Metacide, 5.2; 4-pounds Metacide, 4.3; and in the plot which only received water, 8.9. The control obtained was not sufficient to be considered economically practical.

#### SUMMARY

The cabbage root aphid, *Pemphigus populitransversus* Riley, was found in destructive numbers on the roots of cabbage during the extremely dry growing season of 1951-52. The injury was most severe in those fields suffering from

<sup>2</sup>Identified by C. W. Sabrosky, Bureau of Entomology & Plant Quarantine, U. S. D. A.

lack of water. Cabbage which was irrigated at regular intervals did not show much injury from the cabbage root aphid.

A predator, *Thaumatomyia apache* Sabr., was found feeding on the cabbage root aphid. This predator was more abundant in well irrigated fields than in those suffering from a lack of water.

Insecticides such as parathion, metacide, gamma benzene hexachloride, and TEPP failed to control the cabbage root aphid when applied in the irrigation water.

#### LITERATURE CITED

- Gillette, C. P., and L. C. Bragg. 1915. Notes on some Colorado aphids having alternate food habits. Jour. Econ. Ent., 8: 97-103.  
 Hawley, I. M. 1925. The more important insect injurious to the sugar-beet in Utah. Utah Agri. Expt. Sta. Circ. 54.  
 Hull, F. M. 1929. The plant louse problem of the Texas Gulf Coast. Jour. Econ. Ent., 22: 774-775.  
 Parker, J. R. 1918. The life history and habits of *Chloropisca glabra* Meig., a predaceous Oscinid (Chloropid). Jour. Econ. Ent., 11: 368-380.

### ANNUAL REPORTS OF PROCEEDINGS AND SPECIAL PAPERS

1892-1931

#### ANNUAL REPORTS

|                                                      |             |
|------------------------------------------------------|-------------|
| First to Fortieth (except 11th and 18th).....        | \$1.00 each |
| Set of First to Fortieth (except 11th and 18th)..... | \$30.00     |

#### SPECIAL PAPERS

|                                                                                                            |        |
|------------------------------------------------------------------------------------------------------------|--------|
| 1. Sandusky Flora. pp. 167. E. L. Moseley.....                                                             | \$1.00 |
| 2. The Odonata of Ohio. pp. 116. David S. Kellicott.....                                                   | 2.00   |
| 3. The Preglacial Drainage of Ohio. pp. 75. W. G. Tight, J. A. Bownocker, J. H. Todd and Gerard Fowke..... | 1.00   |
| 4. Tabanidae of Ohio. pp. 63. James S. Hine.....                                                           | 1.00   |
| 5. The Ecological Study of Big Spring Prairie. pp. 96. Thomas A. Bonser.....                               | .75    |
| 6. The Coccidae of Ohio. I. pp. 66. James G. Sanders.....                                                  | 1.00   |
| 7. Batrachians and Reptiles of Ohio. pp. 54. Max Morse.....                                                | 1.50   |
| 8. Ecological Study of Brush Lake. pp. 20. J. H. Schaffner, Otto E. Jennings, Fred J. Tyler.....           | .75    |
| 9. The Willows of Ohio. pp. 60. Robert F. Griggs.....                                                      | .75    |
| 10. Land and Fresh-water Mollusca of Ohio. pp. 35. V. Sterki.....                                          | 1.00   |
| 11. Discomycetes in the Vicinity of Oxford. pp. 54. Freda M. Bachman.....                                  | .75    |
| 12. The Pteridophytes of Ohio. pp. 41. John H. Schaffner.....                                              | 1.00   |
| 13. Fauna of the Maxville Limestone. pp. 65. W. C. Morse.....                                              | .75    |
| 14. The Agaricaceae of Ohio. pp. 116. W. G. Stover.....                                                    | 2.00   |
| 15. An Ecological Study of Buckeye Lake. pp. 138. Frederick Detmers.....                                   | 1.00   |
| 16. Flora of the Oak Openings West of Toledo. pp. 56. E. L. Moseley.....                                   | .75    |
| 17. The Cedar Cliffs Prairie Opening of the Cincinnati Region. pp. 36. N. Mildred Irwin.....               | .75    |
| 18. Milk Sickness Caused by White Snakeroot. pp. 171. E. L. Moseley.....                                   | .75    |

Please make checks payable to the Ohio Academy of Science. Residents of Ohio please include sales tax.

Address: GIFT AND EXCHANGE LIBRARIAN  
 The Ohio State University, Columbus 10, Ohio.

# THE EFFECTS OF REPEATED INJECTIONS OF CHORIONIC GONADOTROPIN ON THE TESTES OF THE LEOPARD FROG (*RANA PIPIENS* SCHREBER)

ROBERT P. MCCOURT

*Department of Zoology and Entomology, The Ohio State University, Columbus 10*

Although certain aspects of the effects of chorionic gonadotropin of human pregnancy urine on male salientia have been described, there is no information concerning the effects of repeated injections of the hormone on the testes and in particular on the process of spermatogenesis. It is commonly known that injections of chorionic gonadotropin of pregnancy urine cause release of sperm from the testes of male frogs and toads. This is the basis of the well known male amphibian pregnancy test.

Studies of the seasonal cycle of spermatogenesis in *Rana pipiens* have been undertaken by several writers. Rugh (1939) and Glass and Rugh (1944) described the meiotic stages present (including spermatozoa) at different seasons of the year. They described the effects of injections of macerated frog anterior pituitary on sperm release but mentioned nothing concerning the effects of the hormone on spermatogenesis. Biesinger and Miller (1952) described the same cycle and also described the effects of both injections of frog anterior pituitary and chorionic gonadotropin from human pregnancy urine on sperm release but mentioned nothing concerning the effects of either of these hormones on spermatogenesis. Van Oordt *et al* (1951) found that repeated injections of "gestyl" (a gonadotropic hormone extracted from the serum of pregnant mares) or of frog anterior pituitary stimulated spermatogenesis in hibernating *Rana temporaria*. However, injections of "gestyl" did not cause the release of spermatozoa. This study describes the effects of repeated injections of commercial chorionic gonadotropin on the testes and on spermatogenesis.

## MATERIALS AND METHODS

The experimental animal used was the male leopard frog (*Rana pipiens* Schreber). A weight of 30 gms was used as a minimum indication of sexual maturity. The animals were received from Alburg, Vermont, in January and were kept under refrigeration at approximately 7°C and were not fed until the completion of the experiment in February. The chorionic gonadotropin used was purchased under the brand name "A. P. L." and is extracted from human pregnancy urine. The supply used was obtained from the Ohio State University Hospital, Columbus 10, Ohio.

The experimental animals were given two daily injections of 2 cc of chorionic gonadotropin (25 International Units per cc) for a period of 8 days. At the end of this time immature sperm or a considerable decrease in the quantity of sperm released could be detected by microscopic examination of the urine of the frogs. At intervals of three days following the injections, the testes of two of the frogs were removed and prepared for study. The testes of the injected frogs were compared with testes taken from uninjected control animals and with accounts given by Rugh (1939), Glass and Rugh (1944), and Biesinger and Miller (1952). All tissues were fixed with Bouin's solution, dehydrated and cleared in dioxan, sectioned at ten microns, and stained with Delafield's haematoxylin.

## RESULTS

The testis of the frog is surrounded by an extremely thin peritoneum consisting of elongate epithelial cells. Beneath this is a connective tissue capsule (tunica albuginea) which extends into the interior of the testis between the seminiferous tubules. Between the seminiferous tubules is the interstitial tissue consisting of ovoid, granular cells. Within the testis are the radially arranged seminiferous tubules. Most of them converge at the center of the testis where there are longitudinal collecting tubules leading to the vasa efferentia. The tubules terminate blindly beneath the tunica albuginea and in many cases branch before reaching the periphery. These relationships are shown in figure 1. The seminiferous tubules are composed of large spindle-shaped epithelial cells which form a complete membrane around each tubule. Within the tubules of the hibernating frog the most conspicuous cells are the mature spermatozoa. They appear as darkly staining rod-shaped bodies and are clustered around the larger sertoli cells which are frequently binucleated. The tails of the spermatozoa lie free within the lumen of the tubule but in most cases they are not visible as they do not stain with haematoxylin. In some cases spermatogonia can be seen just beneath the epithelial layer. They are small rounded cells in contrast to the larger ovoid sertoli cells and the smaller spindle-shaped epithelial cells. In most cases no more than a single layer was present although in a few cases there were two layers of these cells. In no case was there any evidence of primary or secondary spermatocytes although in a few cases late spermatid stages were present. These relationships are shown in figures 1 and 2.

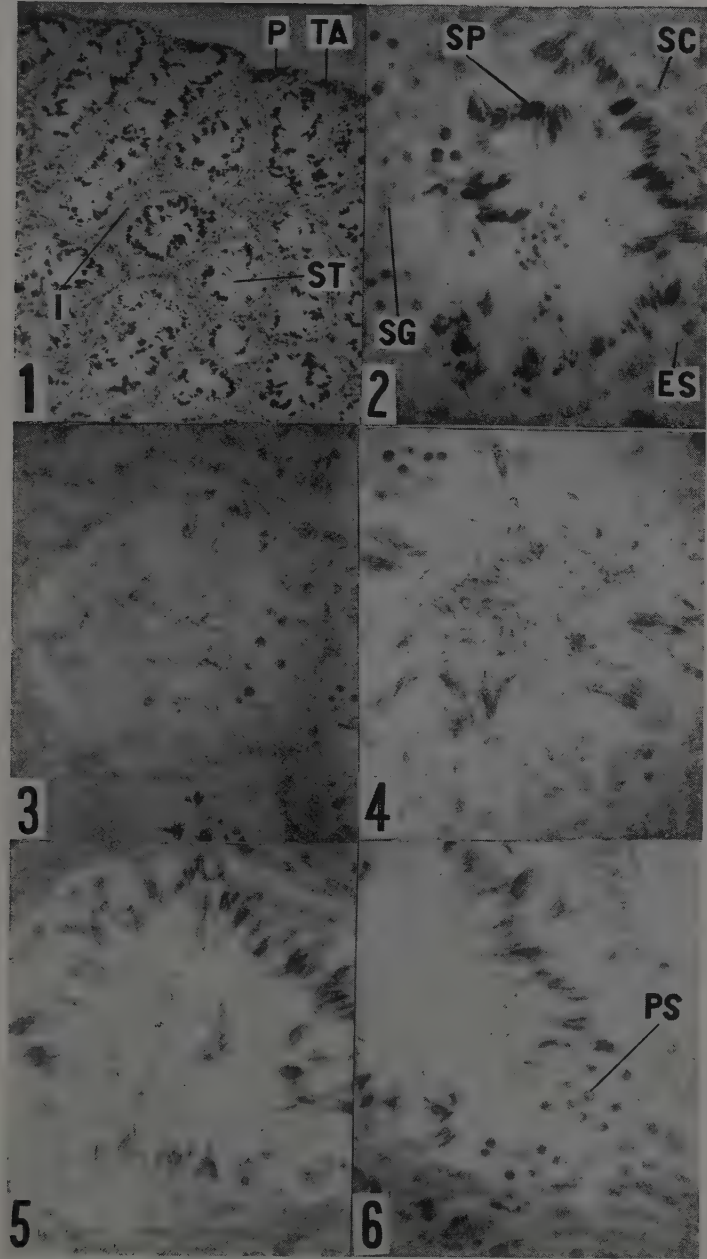
Upon examination of the sectioned testes of the injected animals the most striking difference was the release of the mature spermatozoa. However, it must be pointed out that great differences existed in the amount of sperm released from different seminiferous tubules. In some cases the tubules were empty except for a few sperm in the lumen (fig. 3). In other cases large numbers of sperm still remained in the lumen (fig. 4). In others, large numbers of sperm were still attached to the sertoli cells while many were free in the lumen (fig. 5). These three types of tubules may exist in the same section indicating that sperm release is not uniform throughout any individual testis. In many cases a striking relationship was obvious. The anterior portion of the testis was virtually devoid

## EXPLANATION OF FIGURES IN PLATE

1. Section through the testis of an uninjected hibernating frog. 88 X.
2. Section through the testis of an uninjected hibernating frog showing one seminiferous tubule. 366 X.
3. Section through the testis of an injected frog showing almost complete release of spermatozoa from one seminiferous tubule. 366 X.
4. Section through the testis of an injected frog showing moderate release of spermatozoa from one seminiferous tubule. 366 X.
5. Section through the testis of an injected frog showing almost no release of spermatozoa from one seminiferous tubule. 366 X.
6. Section through the testis of an injected frog showing prophase stages of primary spermatocytes. 366 X.

## ABBREVIATIONS USED IN FIGURES

- ES. Epithelium of seminiferous tubule.
- I. Interstitial tissue.
- P. Peritoneum.
- PS. Prophase stages of primary spermatocytes.
- SC. Sertoli cell.
- SG. Spermatogonium.
- SP. Mature spermatozoa.
- ST. Seminiferous tubule.
- TA. Tunica albuginea.



of sperm. Progressing towards the posterior end the quantity of sperm in the tubules increased and the posterior portion of the testis was virtually unaffected. Although Biesinger (1951) reported an increase in the size of the seminiferous tubules, it was not apparent in the sections studied. The variation in tubule size in the testis of the control animals made it impossible to determine whether changes had occurred.

Other changes were not apparent in the sections made soon after the completion of the injections but became obvious in sections made more than ten days after the injections had been stopped. The first of these was a decrease in the extent of the interstitial tissue. Although this difference was apparent only in areas where sperm release was extensive it was striking in these cases. This agrees with the changes occurring in the normal seasonal cycle following the breeding season as reported by Glass and Rugh (1944). Although Rugh (1939) and Glass and Rugh (1944) reported that there was no change in the interstitial tissue following injections of frog anterior pituitary, they did not give repeated injections nor did they examine the testes after more than forty-eight hours following the injections. It is apparent, then, that this change is due either to repeated injections or that it does not become visible until sometime after the injections.

The other change was the appearance of prophase stages of primary spermatocytes. They were interpreted as leptotene, zygotene and pachytene stages of the first meiotic division. Examples of these cells are shown in figure 6. The occurrence of these stages was in no way related to the amount of sperm released in that particular area of the testis or to the amount of sperm released in that particular testis. These stages may be found in tubules which are almost devoid of sperm or in tubules which are affected only to a limited extent. This agrees with the work of Van Oordt *et al* (1951) who found that injections of "gestyl" stimulated spermatogenesis although no spermatozoa were released.

#### DISCUSSION

Little information is available concerning the mechanism of sperm release in amphibians, either after injections of chorionic gonadotropin of human pregnancy urine or in the normal sexual cycle. It has been suggested by Rugh (1939) that smooth muscle is involved. In this study no positive evidence of the presence of smooth muscle in the testis could be found. Further studies and the use of special staining techniques are now being undertaken in an attempt to answer this question. Another possible cause of sperm release is pressure produced by the diffusion of fluid into the testicular cells. Giltz and Miller (1950) found that injections of large quantities (10 to 12 cc) of distilled water caused the release of spermatozoa. Undoubtedly there are many factors involved. This investigation is a preliminary attempt to determine some of the effects of chorionic gonadotropin other than the release of spermatozoa.

#### SUMMARY AND CONCLUSIONS

1. The testis of the hibernating frog (*Rana pipiens* Schreber) is characterized by the presence of mature spermatozoa attached to sertoli cells at the periphery of the seminiferous tubules and the absence of maturation stages (primary and secondary spermatocytes).

2. Injections of chorionic gonadotropin of human pregnancy urine cause the release of spermatozoa from the testes of the frog into the urine where they can be examined microscopically.

3. The testis shows several changes following repeated injections of the hormone. They are a decrease in the extent of the interstitial tissue and the appearance of prophase stages of primary spermatocytes. Sperm release is not uniform throughout any individual testis.

4. The beginning of maturation is a result of an increase in gonadotropin rather than the release of spermatozoa while the decrease in the extent of the interstitial tissue is apparently related to the release of spermatozoa.

#### ACKNOWLEDGMENTS

The writer wishes to express his thanks to Dr. David F. Miller and Dr. John W. Price for their assistance during the course of this investigation.

#### LITERATURE CITED

- Biesinger, D. I. 1951. A study of seasonal variation and hormone induced changes in the gonads of the male frog, *Rana pipiens*. Ph.D. diss., The Ohio State University, Columbus.
- Biesinger, D. I., and D. F. Miller. 1952. Seasonal and hormone induced changes in the testes of *Rana pipiens*. Ohio Jour. Sci., 52: 169-175.
- Giltz, M. L., and D. F. Miller. 1950. Ways of improving the male frog test for pregnancy. Ohio Jour. Sci., 50: 205-209.
- Glass, F. M., and R. Rugh. 1944. Seasonal study of normal and pituitary stimulated frog *Rana pipiens*. Jour. Morph., 74: 409-428.
- Rugh, R. 1939. Reproductive processes of the male *Rana pipiens*. Jour. Exp. Zool., 80: 81-105.
- Van Oordt, G. J., J. W. Sluiter, and P. G. W. J. Van Oordt. 1951. Spermatogenesis in normal and hypophysectomized frogs (*Rana temporaria*) following gonadotrophin administration. Acta. Endocrin., 7: 257-269.

---

**Pasture Production and Management.** R. H. Lush. The Blakiston Company, Inc., New York. 1952. x+193 pp. \$3.75.

This book is planned as a textbook in courses on pasture management. The author describes himself as "an animal husbandman with agronomic experience," but the book is largely agronomic, with enough animal husbandry included to indicate the best use of the agronomic practices.

Mr. Lush has endeavored to cover the field of pastures and pasture management in the entire United States with the single exception of Western range management, which he does not discuss at all. He does mention irrigated pastures in the West.

To discuss pastures over this extent of climate and soil and their utilization by a half dozen different types of livestock is a sizable assignment for 170 pages of text. The book is an excellent outline of the necessities of pasture management, and gives the non-technical reader an idea of the complexity of the subject.

To be used as a text in any given region, it will require extensive supplementing from the experience of that region. This is by no means a criticism of the book. Agronomic problems vary so greatly with soil and climate, and their solution must be so accurately tailored to the interaction of these with the livestock to be handled and economic conditions present, that it is impossible for any one book to cover so large an area in much more than outline form. For example, the author devotes less than half as many pages to choosing pasture plants and establishing pastures as the Ohio Agricultural Extension Service has for many years used in an Extension bulletin on the same topic for Ohio alone.

For this limited outline-type general presentation, it would be hard to improve on the present book. It will undoubtedly be used in many courses on pasture management, as a foundation on which to build more extensive recommendations adapted to the particular area.

One who wishes specific recommendations which he can immediately apply may be seriously disappointed. One who is looking for ideas and suggestions which can be developed and adapted for his particular area will find many of them.

C. J. WILLARD.

## FOUR NEW SPECIES OF JORUMA FROM MEXICO (HOMOPTERA: CICADELLIDAE)

ROBERT F. RUPPEL AND DWIGHT M. DELONG

*Department of Zoology and Entomology, The Ohio State University, Columbus 10*

The genus *Joruma* is readily differentiated from the other typhlocybinae leafhoppers by its open anterior apical cell with the other apical cells of the hind-wing closed. (i.e., the submarginal vein does not extend to the radius of the wing.) The median length of the vertex is equal to its basal width between the eyes and is bluntly angulate. The eyes are very large and ocelli are present and conspicuous. R-m cross vein of the hind wing is present, the anterior transverse vein of the elytron is evascent, the second apical cell of the elytron is quadrate, and the posterior margin of the elytron is serrate. Anal hooks present, pygofer rounded and without processes; plates long and slender; styles short with their preapical lobes poorly developed.

Species of the genus have been described previously by McAtee (1924, 1926), DeLong (1923), Osborn (1928), Oman (1937), and Lawson (1930). Some new species of *Joruma* from Mexico are described below. Types of these species, unless otherwise indicated are in the DeLong collection.

### *Joruma aurea* n. sp.

An ivory-colored species which stands in contrast to the somber colors of the remainder of the species; with unique male genital structures. Length 3.2 mm.

Color: The vertex is ivory with a small orange patch on its disk next to each eye. The pronotum and scutellum are ivory with the basal angles of the pronotum yellow. The elytra are ivory their commissural margins golden. The ventral half of the face is orange, while its dorsal half and the venter of the body are ivory.

Genitalia: Anal hooks short, with their apices turned inwardly. The pygofer are short and rounded apically, and bear a tuft of long hairs on their apical margin. The first extension of the style is very slender and its ventral margin is serrate. The base of the aedeagus appears clavate in ventral view, its dorsal processes are slender, and the phallicata is broad, depressed, and expanded at its apex into a pair of flap-like lateral lobes.

Holotype male labeled Mexico (MB 148) from Plancha Piedra, Guatemala, Oct. 27, 1925 collected by Dr. Dampf from virgin forest area at the Guatemalan Custom Station between Guatemala and British Honduras.

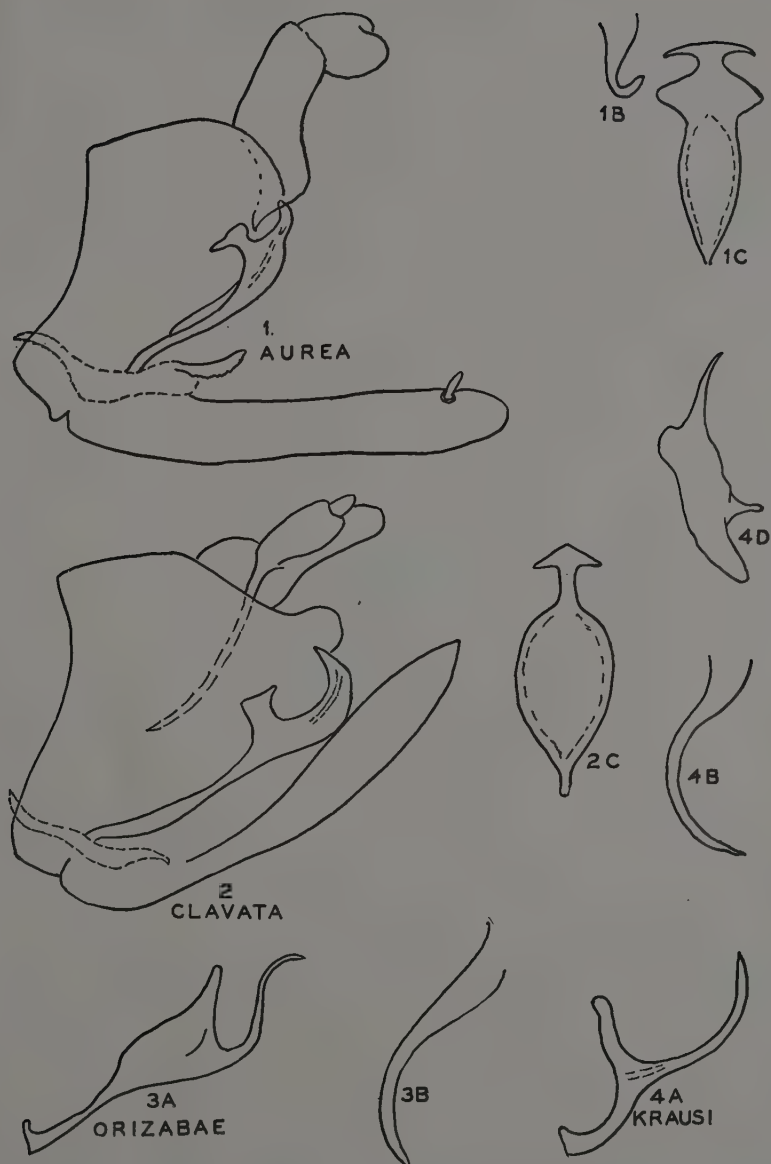
### *Joruma clavata* n. sp.

Strongly resembling *ascripla* McAtee in general appearance, but the cubitus of the hind-wing is unbranched and the male genitalia are unique. Length 3.2 mm.

Color: The vertex, pronotum, and scutellum are cream with the lateral margins of the vertex tinged with red. The elytra are golden with their bases and apical cells smoky. The face and venter are cream with the dorsal portion of the face red.

Genitalia. The apices of the pygofer are turned up into small, sharp points. The anal hooks are long and straight and extend ventro-anteriorly. The base of the aedeagus is depressed and long, appearing clavate in ventral view. The phallicata is slender and curves dorsad with its apex bearing a pair of short, triangular lateral processes.

Holotype male collected at San Jacinta, D. F., June 23, 1932 (MF 2589), by Dr. Dampf; male paratype collected same place, same collector, May 16, 1932 (MF 2551); paratypes Mexico City, D. F., June 12, 1924 (MB 62), Dampf; same locality, Sept. 5, 1939, D. M. DeLong; Vergel, Chis., May 19, 1935 (MF 4201), Dampf; Tamazunchale, S.L.P., Nov. 2, 1945; DeLong, Hershberger, and Elliot.



1—*Joruma aurea*—lateral view of genital capsule; 1b—lateral anal hook; 1c—caudal view of aedeagus. 2—*J. clavata*—lateral view of genital capsule; 2c—caudal view of aedeagus. 3a—*J. orizabae*—lateral view of aedeagus; 3b—lateral anal hook. 4a—*J. krausi*—lateral view of aedeagus; 4b—lateral anal hook; 4d—ventral view of left style.

*Joruma orizabae* n. sp.

A somber colored species which superficially resembles *Neojoruma adusta* (McAtee) but which has the conical head characteristic of *Joruma*. Length 2.8 mm.

Color: The vertex is black with its posterior margin bordered with a fine olive line which broadens toward the eyes. The pronotum and scutellum are olive with the anterior margin of the pronotum bordered with black. The elytra are a translucent olive-green with their bases and their apical cells smoky. The dorsal half of the face is black, while the ventral half is olive.

Genitalia: The anal hooks of the male are long, rather broad, and curve sharply caudad near their apices. The base of the aedeagus is broad and clavate in ventral view, the dorsal processes are thick, and the phallicata is very slender and recurved.

Holotype male labeled Mexico (MF 4239) from Vergel Chiapis, May 21, 1935, collected by Mrs. Dampf; paratypes collected at Orizaba, V. C., Oct. 17, 1941 by DeLong, Good, Caldwell, and Plummer; Finca Prusia, Chis., Dec. 4, 1932 (MF 2843), Dampf.

*Joruma krausi* n. sp.

A small cream and tan colored species which resembles *curvata* Osborn in general form but has distinctive coloration and genitalia. Length 2.6 mm

Color: The vertex is cream with median, longitudinal line, a pair of spots at the apex, and a spot near the anterior corner of each eye brown. The pronotum is dark olive with its lateral margins pale and with a pair of median, indistinct, brown spots on its disk. The scutellum is tan with its basal angles brown. The elytra are hyaline with their commissural margins golden and apical cells and costal margins smoky. The face is tan flecked with brown between the eyes. The venter is completely black.

Genitalia: The plates are broad at their bases and narrow abruptly near their centers to long, slender apices. The anal hooks are long and slender and curve mesad. The style is short with its preapical lobe spine-like and the first extension rather broad and short. The base of the phallicata is long and cylindrical and the phallicata is long, slender, curved dorsad, and evenly tapered to a pointed apex.

Holotype male, allotype female, and paratypes collected at Cuernavaca, Mor., April, 1945 by N. H. L. Kraus; paratypes, Chiltepec, Oax., Aug. 10, 1937 (MF 6338), Dampf; Cordoba, V. C., Aug. 15, 1924, A. Dampf. Holotype, allotype, and paratype in the U. S. National Museum. Paratypes in the DeLong collection.

## LITERATURE CITED

- DeLong, D. M. 1923. In Wolcott "Insectae Portoricensis." Jour. Dept. Agric. Porto Rico, 7(1): 1-312.  
Lawson, P. W. 1930. Three new leafhoppers from the South-west (Homoptera: Cicadellidae). Pan-Pacific Ent., 6: 135-138.  
McAtee, W. L. 1924. Notes on eupterygid leafhoppers with descriptions of a few forms. Florida Ent., 8: 33-39.  
McAtee, W. L. 1926. Notes on neotropical Eupteryginæ, etc. Jour. New York Ent. Soc., 34: 141-175.  
Oman, P. W. 1937. New eupterygine leafhoppers from Porto Rico (Homoptera—Cicadellidae). Jour. Agric. Univ. Porto Rico, 21: 567-572.  
Osborn, H. 1928. Neotropical Homoptera of the Carnegie Museum. Ann. Carnegie Mus., 18: 253-298.

# AN ARTESIAN SYSTEM IN THE SHARON CONGLOMERATE NEAR CHARDON, OHIO

GLENN C. TAGUE

*Department of Geology and Geography, Western Reserve University, Cleveland 6, Ohio*

This paper is a summary of the geological information obtained in connection with the drilling of an artesian water system near Chardon, Ohio. The system is located in north central Geauga County, on the property of the Chardon Deep Springs Company, approximately two miles west of Chardon at the intersection of U. S. 6 and Chardon-Auburn Road.

The attention of the writer was first called to this artesian system in the spring of 1950 when the owner of the property requested geological information before starting a new drilling program. It was hoped that the output of water could be substantially increased. The additional water was to be used for the development of a trout stream. The original flowing well, number 1 (fig. 1), on the

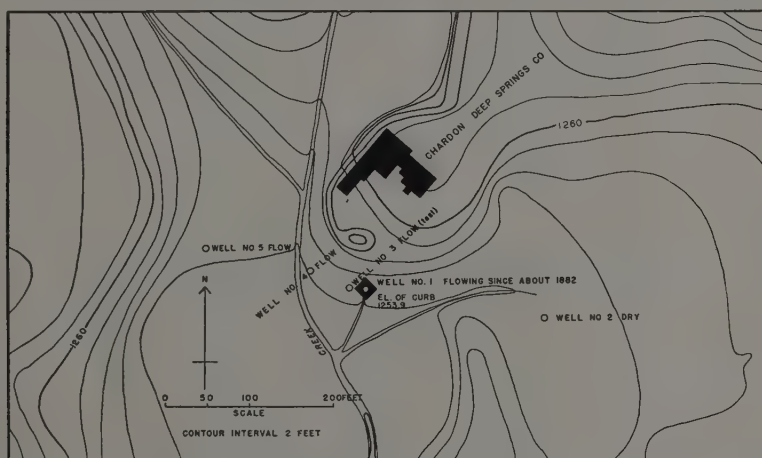


FIGURE 1. Topographic map of a part of the Chardon Deep Springs Co. property showing location of wells. Modified from a map made by T. R. Root for the Chardon Deep Springs Co.

property was drilled by the spring pole method about the year 1880 and it was the only well until the spring of 1950. The original well was drilled for oil, but drilling was stopped after a considerably flow of water hampered the operations. This well is said to have flowed at a rate variously estimated from 3000 gallons per hour to 7000 gallons per hour since it was drilled some 70 or more years ago.

A search of the geological literature brought to light two scant references to the original well. Foulk (1925) gave a chemical analysis of the water and referred to the well as "magnetic well west of Chardon." The other reference was made by Leverett (1902) who stated, "At Wallace Weaver's two miles west of Chardon, there is a flowing well which obtains its water from the sandstone, but penetrates 30 feet of drift before entering rock." Wallace Weaver owned

the property at the time Leverett studied the area. Leverett does not name "the sandstone." There is no log available for the original well and it is doubtful if one was made. Few people are living who can remember the drilling operations. Heresay depths for the original well vary from 275 to 375 feet. Water from the well has been sold for many years for its supposed health giving properties. Early bottle labels and testimonial pamphlets are said to have suggested considerable depth for the well. A sounding made in the spring of 1950 gave an indicated depth of 135 feet. However, it was considered possible that caving of the hole or an obstruction in the hole prevented the lead from going down to the full depth.

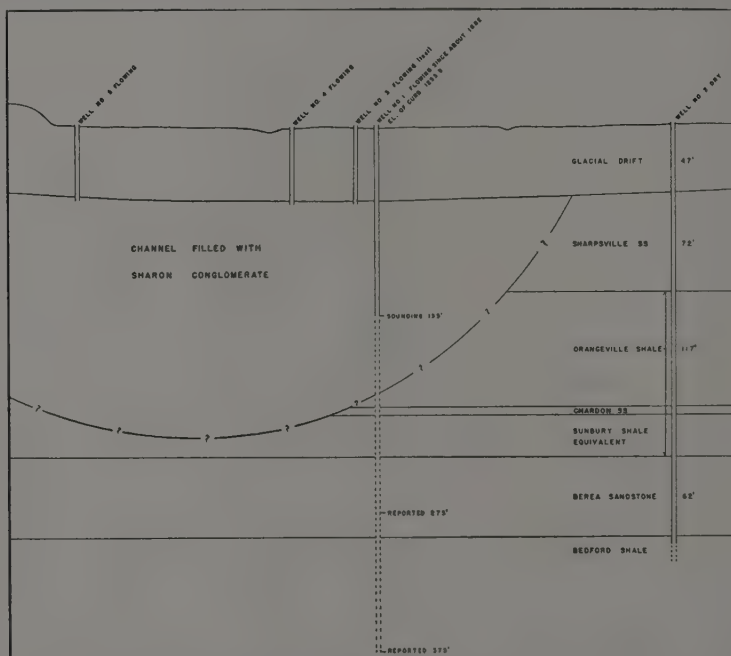


FIGURE 2. East-west cross-section between wells number 2 and 5 showing the buried channel filled with Sharon conglomerate and the capping of glacial drift.

The Sharon conglomerate caps the hills in the immediate vicinity of the property forming the east and west sides of the small valley in which the property is located. The base of the Sharon conglomerate appeared to be well above the ground surface near the original well. This observation was partially substantiated with the drilling of well number 2 which entered the Sharpsville sandstone directly below the glacial drift (fig. 2). The Sharon conglomerate was ruled out as the probable source of the water from the original well and on the basis of the available information, it seemed reasonable to expect the water to be coming from the Berea sandstone.

An extension was placed on the casing of the original well (number 1) and the static water level was found to be seven feet above the well curb or at an elevation of 1,260.9 feet. Two new well locations were surveyed. Due to the low

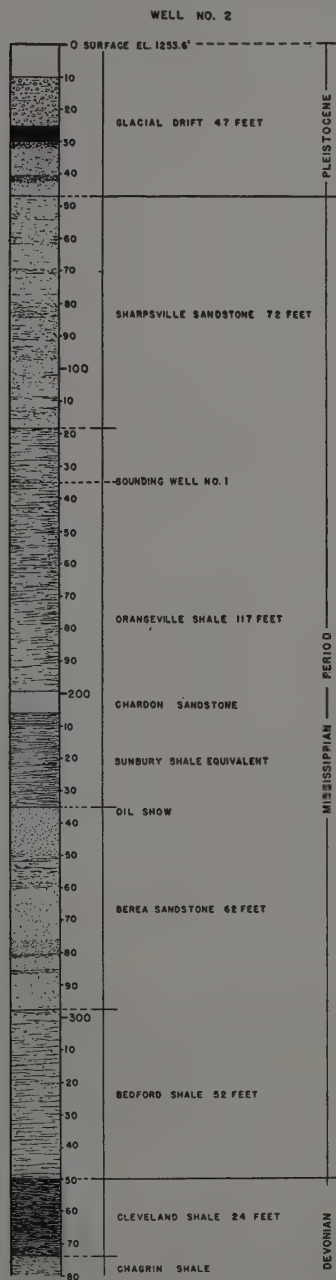


FIGURE 3. Detailed log of well number 2.

static water level and the narrowness of the valley it was impossible to make locations little more than 200 feet east or 200 feet west (transverse to the valley) of the original well (fig. 1) before reaching surface elevations too high for flowing conditions. Locations to the south and down the valley would have increased the head but were ruled out because of the intended use of the water for a trout stream. The stream was to start near the north edge of the property and flow south down the valley along the natural drainage.

Drilling began first on the east side of the original well (hereafter referred to as well number 1) at well number 2. Samples of the drill cuttings were taken at five foot intervals on this well. The samples were carefully washed and a detailed log (fig. 3) was made. The drill passed through 47 feet of glacial drift consisting of till, gravel, sand, and clay. A small flow of water was obtained from a layer of gravel near the bottom of the drift. The drill then passed through 72 feet of Sharpsville sandstone, followed by 117 feet of Orangeville shale before reaching the top of the Berea sandstone at a depth of 235 feet. A show of oil was found in the top of the Berea sandstone, but no water. Drilling continued through the Berea sandstone in the hope that the source of the water might be near its base. Before drilling operations were suspended the hole was made through 62 feet of Berea sandstone, 52 feet of Bedford shale, 24 feet of Cleveland shale and had penetrated 5 feet into the Chaprin shale. Well number 2 was a dry hole.

Before further efforts at more distant locations, a test hole was then drilled about 25 feet west of well number 1 to determine its source of water. The test hole, well number 3, passed through 50 feet of glacial drift and entered a yellowish quartz sandstone with quartz pebbles. When the sandstone was penetrated a strong flow of water issued from the casing and well number 1 stopped flowing. The top of the casing on well number 3 was approximately two feet below the top of the casing on well number 1. The pebbly sandstone was identified as Sharon conglomerate. The 275 feet to 375 feet as indicated depths for the source of the water in well number 1 had turned out to be a mere 50 feet.

Wells 4 and 5 were drilled west of well number 1. These wells penetrated the Sharon conglomerate at a depth of 50 feet and both were flowing. The flowing wells appear to have been drilled into a channel filled with Sharon conglomerate and capped by glacial drift. The eastern edge of the channel (fig. 2) lies somewhere between well number 1 and the dry hole, well number 2. The western edge of the channel is indeterminable, but is situated somewhere west of well number 5. All four flowing wells, numbers 1 (original), 3, 4, and 5, are within a horizontal distance of 420 feet. Each well effects the others and it is doubtful if the owner has appreciably increased his over-all supply of water. Two years later the flow and static water level appear to have been little effected by the three additional holes.

Thanks for assistance on this project are due Professor Myron T. Sturgeon of Ohio University and Mr. Ralph J. Bernhagen, Principal Geologist, Division of Water for Ohio. Thanks are also due Professor J. Osborn Fuller of Ohio State University for encouragement in presenting this material for publication.

#### LITERATURE CITED

- Foulk, C. W. 1925. Industrial Water Supplies of Ohio. Ohio Geol. Surv. Bull. 29: 250.  
Leverett, F. 1902. Glacial Formations and Drainage Features of the Erie and Ohio Basins. U. S. Geol. Surv. Mono. 41: 643.

# A SYSTEMATIC STUDY OF THE MAIN ARTERIES IN THE REGION OF THE HEART. AVES XIII.

## CICONIIFORMES, PART 2<sup>1</sup>

FRED H. GLENNY

*Department of Anatomy, The Ohio State University, Columbus 10*

Further studies on the arrangement-pattern of the main arteries in the neck and thorax of 19 species of Ciconiiformes reveals the presence of a basic ordinal arrangement of these vessels, and further substantiates the view of Glenný (1945) that there are notable steps in the evolution of the carotids from a bicarotid to unicarotid condition. As has been shown by Garrod (1873) and Glenný (1945), union of the carotid (trunk) arteries results in the conjugate condition. Subsequent reduction of the basal portion of either side (usually the left side in the Ciconiiformes) may lead to complete loss of the reduced vessel.

It may be noted that there is not any notable uniformity in occurrence of these reductions with respect to generic status at the present time. As a result, bicarotid and conjugate carotids may occur in different species of a single genus. Furthermore, these variations may occur in the several families and subfamilies since they are not restricted to any single grouping of genera.

The characteristic ordinal arrangement-pattern for the Ciconiiformes is as follows; bicarotidinae-normales (with variations); ligamentum aortae present; ligamentum botalli reduced or lacking; branches of subclavian artery: coracoid or sterno-clavicular, axillary, internal mammary or intercostal, two pectorals; branches of the common carotid: ductus shawi and tracheal, thyroid, superficial cervical (comes nervi vagi), vertebral, internal carotid (trunk).

The following species have been studied, and differences in the arrangement-pattern noted. Unless otherwise noted, the following species present the pattern characteristic of the order.

### ARDEIDAE:

*Ardea herodias treganzai* Court: conjugate carotids, ligamentum botalli present but reduced.

*Ardea herodias herodias* (Linnaeus): bicarotid, ligamentum botalli present.

*Butorides virescens virescens* (Linnaeus): conjugate carotids, ligamentum botalli lacking.

*Butorides sundevalli* Reichenow: bicarotid, ligamentum botalli lacking.

*Florida caerulea* (Linnaeus): bicarotid, no ligamentum botalli.

*Ardeola speciosa* (Horsfield): conjugate carotids, left side reduced to about  $\frac{1}{3}$  that of the right side, no ligamentum botalli.

*Bubulcus ibis coromandus* (Boddaert): bicarotid, ligamentum botalli much reduced and partial.

*Bubulcus ibis ibis* (Linnaeus): same as above.

*Dichromanassa rufescens rufescens* (Gmelin): same as above.

*Casmerodius albus albus* (Linnaeus): same as above.

*Demiegretta sacra* (Gmelin): same as above, small ventro-lateral superficial cervicals also arise from base common to thyroids.

*Leucophox thula brewsteri* (Thayer & Bangs): conjugate carotids, ligamentum botalli absent.

*Hydranassa tricolor ruficollis* (Gosse): bicarotid, ligamentum reduced or fused to radix aortae.

<sup>1</sup>Contribution of Blue Sea Lake Biological Laboratory, Messines, Quebec.

*Nyctanassa violacea pauper* (Selater & Salvin): bicarotid, ligamentum botalli reduced to a white linea botalli on the face of the right radix aortae.

*Ixobrychus minutus minutus* (Linnaeus): bicarotid, ligamentum botalli present.

*Ixobrychus sinensis bryani* (Seale): bicarotid, ligamentum botalli absent.

*Botaurus lentiginosus* (Montagu): conjugate carotids, ligamentum botalli lacking.

#### COCHLEARIIDAE:

*Cochlearius cochlearius zeledoni* (Ridgway): bicarotid, linea botalli present.

#### THREKIORNITHIDAE:

*Guara alba* (Linnaeus): bicarotid, ligamentum botalli short.

The writer wishes to express his gratitude to Dr. Herbert Friedmann, Curator, Division of Birds, U. S. National Museum, and to Mr. J. W. Cowland, Curator, Sudan Government Museum, Natural History, Wad Medani (Sudan), for their assistance in making available the materials for this study.

#### REFERENCES

- Garrod, A. H. 1873. On the carotid arteries of birds. London, Proc. Zool. Soc., 457-472.  
 Glenny, F. H. 1945. A systematic study of the main arteries in the region of the heart—  
 AVES XIII. Ciconiiformes, Part 1. Amer. Mid. Nat., 33: 449-454.

---

**General Genetics.** *Adrian M. Srb and Ray D. Owen.* W. H. Freeman and Company, San Francisco, California. 1952. x+561 pp. \$5.50.

In slightly more than 50 years, genetics has developed from an unnamed study based upon a handful of facts and a few principles to a mature science embracing countless facts and numerous generalizations, and touching actively almost all the other important branches of biology. To impart the full flavor of modern genetics to college students by means of a single textbook is a nearly impossible task. This book by Srb and Owen is a very close approach to the ideal. Students who use this book will become acquainted with the ideas of classical genetics (segregation of alleles, random assortment of non-alleles, linkage), with cytogenetics and chromosome mapping, with developmental, biochemical, and physiological genetics, with quantitative genetics and practical plant and animal breeding, and with population genetics and other aspects of statistical genetics. The examples and illustrations are excellent. The only notable shortcoming is the failure to develop a historical perspective. Mendel's work is briefly referred to but not discussed.

E. L. GREEN.

---

**Geography of Living Things.** *M. S. Anderson.* Philosophical Library, New York. 1952. 202 pp. \$2.75.

In the concluding chapter of this small volume the author expresses the hope that the reader has gained a point of view from the material presented therein. That point of view is not generally acceptable to professional geographers in the United States at the present time since it is almost wholly concerned with adaptation of animal organisms to the natural surroundings of their immediate environment. After a brief introduction, Chapter II discusses "Man as an Animal," and this is followed by a chapter entitled "Direct Effects of his Environment on Man," which could have been abstracted in thought, if not word, from an American or English geography text of thirty-five years ago.

The chapters that follow include discussion of "Man, Rocks and Water," "Man and His Food," soil, soil conservation, and pests and diseases of plants, animals and man.

The volume is written in a vocabulary that is probably focused on the secondary level and unfortunately it is of the "Now children, let us explore the matter" approach. There is no doubt that a high school student totally unfamiliar with the simplest phases of biological geography would profit from a reading of the book but the information provided by the author would be spotty and highly unorganized. The reviewer senses a strong feeling that the author is opposed to unrestrained growth of human populations and is fearful of a future in which the human race will decline or disappear because of inadequate food supplies. Perhaps this is a reasonable view in underfed England but it certainly fails to reflect the conditions that prevail in many other parts of the world that are capable of producing more foodstuffs than they do at present.

H. F. RAUP.

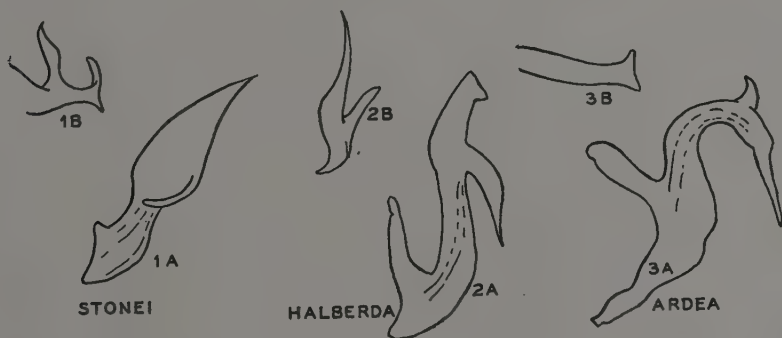
# THREE NEW SPECIES OF DIKRANEURA FROM MEXICO (HOMOPTERA: CICADELLIDAE)

ROBERT F. RUPPEL AND DWIGHT M. DELONG

*Department of Zoology and Entomology, The Ohio State University, Columbus 10*

*Dikraneura* is a holarctic genus composed of rather large, slender species separated from the other typhlocybines by having the second apical cell quadrate and the anterior transverse vein proximated to the other transverse veins. The genus is differentiated from its close relatives, *Forcipata* and *Notus*, in lacking the caliper-like plates of the former and the greatly enlarged valve of the latter. The bulk of the New World species are described and figured in the paper of DeLong and Caldwell (1937) and Beamer (1943).

In Mexico, species of the genus are restricted to the pine regions of the higher altitudes. Six species of *Dikraneura* from Mexico have been examined: *arizona* Del. and Cald., *serrata* Del. and Cald., *luna* Del. and Cald., and three new species. These new species are described below.



FIGURES 1-3. 1a—*Dikraneura stonei*—lateral view of aedeagus; 1b—lateral pygofer hook. 2a—*D. halberda*—lateral view of aedeagus; 2b—left pygofer hook. 3a—*D. ardea*—lateral view of aedeagus; 3b—lateral pygofer hook.

## *Dikraneura stonei* n. sp.

Resembling *serrata* Del. and Cald. in general form and appearance, but with unique coloration and genitalia. Length 3.6 mm.

**Color:** The vertex, pronotum, and scutellum are light yellow, the former two crossed by paired, median, longitudinal, red vittae which extend from the apex of the vertex to the posterior margin of the pronotum. The elytra are translucent golden with a pair of thin, longitudinal red stripes on each clavus, and a broader, brown, longitudinal stripe on each corium. The face is light tan while the venter is a darker tan.

**Genitalia:** The genital capsule resembles that of *arizona* but the pygofer hooks are broader and each bears a dorsal point near its middle, at its apex, and a ventral point at its apex. The aedeagus is very long, compressed, and recurved; it bears a pair of bifurcate processes near the middle of its ventral margin and a pair of lateral, reflexed processes at its apex.

Holotype male collected at Mexico, Cuernavaca Rd., Mex., Aug. 20, 1936 by Ball and Stone. Type in the U.S.N.M.

*Dikraneura halberda* n. sp.

Resembling *serrata* DeLong and Caldwell and *stonei* in general appearance but with distinctive genitalia. Length 4.1 mm.

**Color:** The vertex, pronotum, and scutellum are cream. A pair of broad longitudinal, red vittae extend from the apex of vertex to the scutellum. The elytra are hyaline with a pair of longitudinal stripes on each clavus and the areas between the bases of the sectors orange-red. The face and venter are immaculate cream.

**Genitalia:** The pygofer hooks are broad at their bases, taper to sharp apices, and bear meso-anteriorly directed processes on their mesal faces. The phallicata is strongly compressed and bears a short strongly-curved process at its apex, a pair of short flap-like ventro-lateral processes near its apex, and a pair of appressed ventrally-directed spindle-shaped processes near the middle of its ventral margins.

Holotype male and male paratypes collected at Mexico, D. F., Sept. 13, 1939 by D. M. DeLong; male paratype Orizaba, V. C., Oct. 17, 1941, DeLong, Good, Caldwell, and Plummer; male paratypes Desierto de los Leones, D. F., Jan. 8, 1933 (MF 2913) Dampf; male paratypes Chapultepec Hts., D. F., Nov. 16, 1926 (MB 150), Dampf. Types in the DeLong collections.

*Dikraneura ardea* n. sp.

Resembling *halberda* in general form and appearance but with distinctive male genital structures. Length 4.2 mm.

**Color:** The vertex, pronotum, and scutellum are cream crossed by a pair of longitudinal red vittae which extend from the apex of the vertex to the scutellum. A median, fine, red line extends longitudinally across the pronotum. The elytra are hyaline with a pair of stripes on each clavus and lines on each corium red. The face and venter are immaculate cream.

**Genitalia:** Genital capsule, styles, and connective similar to *halberda*. The pygofer hook is nearly parallel-sided and terminates in a foot-shaped apical process. The base of the aedeagus is elongate with the dorsal processes arising remote from the articulation with the connective. The phallicata is slender and reflexed and bears a dorsal pre-apical spine-like process and a pair of slender, lateral-apical processes.

Holotype male collected at Zamora, Mich., Oct. 2, 1941 by DeLong, Good, Caldwell, and Plummer. Type in the DeLong collection.

## LITERATURE CITED

- Beamer, R. H. 1943. Notes and descriptions of some species of *Dikraneura* (Homoptera: Cicadellidae). Jour. Kansas Ent. Soc., 16: 54-63.  
DeLong, D. M., and J. S. Caldwell. 1937. The genus *Dikraneura*—A study of the male genitalia—With descriptions of new species. Proc. Ent. Soc. Washington, 39: 17-34.

---

**Evolution in the Genus *Drosophila*.** J. T. Patterson and W. S. Stone. Macmillan Company, New York. 1952. ix+610 pp. \$8.50.

The study of particular genera or species has in the past contributed valuable information concerning evolutionary processes at the level of speciation, and will undoubtedly contribute even more in the future. It seems unlikely, however, that any genus will be subjected to as intensive investigation from so many points of view as has the genus *Drosophila*. The taxonomy, comparative anatomy, embryology, comparative physiology, geographical distribution, ecology, cytology, and genetics of this genus have all been studied during the past thirty-five years, and all contribute to a structure of evolutionary knowledge surpassing that for any other genus. Only paleontological data are missing.

The authors of this volume have been among the leaders of this notable development, and they have made a signal contribution by bringing together in one place this immense body of knowledge. Their contribution goes far beyond mere compilation, however, for their synthesis of this material constitutes an important contribution to the theory of evolution. This is a book which should prove of great value to experts and students alike for many years to come.

ALLEN S. FOX.

## STRIPMINE RECLAMATION RESEARCH IN OHIO<sup>1</sup>

LYLE L. KNUDSEN AND PAUL H. STRUTHERS

*Ohio Agricultural Experiment Station, Wooster*

Many problems have arisen in conjunction with the accelerated coal-stripping industry of Ohio. They concern widely-varying phases, from revegetation of the spoils to economic effects of stripping on community organization. Because of the rough terrain left by stripping shovels and the natural vegetation surrounding the stripped area, most early concepts of reclamation centered around the establishment of forest trees. The Central States Forest Experiment Station began making tree plantings on coal spoils in central Ohio in 1937, and has carried on a forestry research program since that time. Recent experience has shown that agricultural crops, such as pastures, berries, and orchards may have a place in the reclamation program. Also, the extreme variability of results of all types of plantings, caused by chemical and physical relationships of spoil material, pointed to the need for basic information. In order to supplement earlier work which was done with trees, and to begin investigations aimed at finding out how to establish plants successfully on as many spoil types as possible, the Ohio Agricultural Experiment Station undertook stripmine reclamation research in 1950.

There has been considerable progress in the reclamation of Ohio's spoil banks since the days of the first reported stripping in Jefferson County in 1913. Early reclamation attempts were sincere efforts by the coal operators to revegetate the spoils. Dean (1925) reported that the Wayne Coal Company had devoted 45 acres to forestry work in Jefferson and Harrison Counties. Black locust was planted almost exclusively at that time. By 1937, about 200 acres had been planted in Ohio to black locust, white ash, red oak, black walnut, and several species of pine. Recent examinations of some of these areas show that the locust has been damaged extensively by the locust borer. Volunteer black cherry, elm, and other hardwoods are gradually invading the areas. The locust has generally failed to produce good commercial fence posts as intended, but has served as a nurse crop to speed succession along. In 1940, the formation of the Ohio Reclamation Committee, later known as the Ohio Reclamation Association, marked the first attempt by the operators to solve their reclamation problems by cooperative action.

Increasing pressure of public opinion caused the passage in 1947 of the first Ohio stripmine reclamation law, and in 1949 the now effective coal stripmine land reclamation act. This act provides that a bond of \$190 per acre will be forfeited by the operator if grading and planting are not completed within two years after stripping; spoils are to be graded to gently rolling topography and planted according to a previously approved plan. To administer the law, the 1949 act established the Division of Reclamation under the Ohio Department of Agriculture. This Division licenses coal operators, helps them plan reclamation work, holds their bond until the work is completed, and makes a final inspection to see if reclamation meets the provisions of the law. Administration of the law is the function of the Division of Reclamation; the Ohio Agricultural Experiment Station is at present responsible for solving the technical difficulties of revegetation of spoils.

---

<sup>1</sup>A paper presented at the sixty-first annual meeting of the Ohio Academy of Science, Kent, Ohio, April 18, 1952.

The reclamation research program of the Ohio Agricultural Experiment Station includes the following phases of the stripmine problem: a survey is being made to determine the amount and distribution of the land directly affected by coal stripping in the state; observations of plantings made by coal operators are continually carried on; experimental plantings of trees, pasture plants, and berries are being made; basic laboratory research concerning the spoil materials is supplementing the field observations; and greenhouse studies are being conducted.

Before a comprehensive plan for carrying on stripmine research could be completed, knowledge about the areas requiring reclamation was essential. During 1951 new aerial photographs of the state became available. They were made during 1950 and early 1951 by the Production and Marketing Administration, U. S. Department of Agriculture. After preliminary examinations of sample areas, it was decided that valid estimates of stripped areas could be made directly from the photos with a minimum of effort.



FIGURE 1. Grading stripmine banks, Harrison County, Ohio, January, 1950.

Two results were sought from the photo survey; an outline map of each county showing the approximate extent and location of all stripped land, and an estimate of the stripped area in each county using a method similar to that described by Moessner and Jensen (1951). The two operations were carried out with one examination of the photos. The photos of each county containing stripping were arranged in order; a templet of dots was placed over the net area of each photo. The number of dots to be counted in a given county was based upon the percentage distribution of the two attributes to be tallied, in this case stripped land and non-stripped land. A rough estimate of the percentage of stripped land provided the number of dots required for a precision of ten percent maximum error at the .05 level of significance, used as a goal in each county. Both the dots falling within land affected by stripping and the total dots were tallied; their ratio is equivalent to the ratio of the acres of stripping to the total acres in the county. The area of stripping was computed from this proportion.

The stripped area appearing on each photo was outlined with grease pencil, avoiding duplication, after the dot-tally was completed. Each photo was projected on a county highway map, with photo scale reduced and oriented to that of the map by means of a reflecting projector, and the stripped areas outlined on the county map. Each completed map was traced to show only county outline, county seat, and stripped area. All 27 counties containing stripping were handled in this manner, photographed, and assembled for a state photograph (fig. 3).

Dean (1925) reported that 16,000 acres of Ohio's lands were subject to stripping in Jefferson, Harrison, Tuscarawas, Perry, and Muskingum Counties. Limstrom and Merz (1949) reported about 36,000 acres stripped by 1946, based on an extensive survey of the extent, distribution, and makeup of the spoils of Ohio conducted by the Central States Forest Experiment Station. The Ohio Agricultural Experiment Station survey produced an estimate of 76,000 acres stripped in the state by 1951, with the areas varying from 3 acres in Monroe County to 16,000 acres in Harrison County. Field reconnaissance work to determine distribution of the spoil types will complete the information desired from this survey.

Many coal operators and their representatives very conscientiously spend a great deal of time and money trying to revegetate their spoils. It is only by locating and examining some of the older plantings made long before the compulsion of the reclamation law, that the long-range effects of planting on spoils can be observed. Valuable information has been obtained from study of planting successes and failures of coal operators.



FIGURE 2. Established pasture on same area, October, 1950.

Experimental plantings being made now will furnish information about the treatment necessary for establishment of trees, pastures, and berries, especially on the more acid spoils of the state. Trees being tried include red elm, red maple, hybrid poplar, walnut, and chestnut. Forage crops such as alfalfa, birdsfoot trefoil, bromegrass, timothy, and bluegrass can be successful in the limestone spoil region of eastern Ohio. Experimental plots of these and other forage crops, using different lime and fertilizer applications, have been recently established on acid spoils. Small plantings of blueberries, raspberries, and grapes also are being made with the advice of horticulturists.

Basic research concerning spoil materials has been initiated at the Ohio Agricultural Experiment Station to supplement field plantings and observations. The purpose of this study is to obtain much-needed information regarding the chemical and physical nature of the different spoil types in order to achieve rapid and successful reclamation. Within the state, spoil materials range in pH from about two to nearly eight, and in texture from sands to heavy clays. Plant growth sometimes occurs on quite acid spoils in one area but not on less acid spoils in another; apparently there are toxicities or nutrient deficiencies involved which require chemical determination. The surface of stripped and graded land is

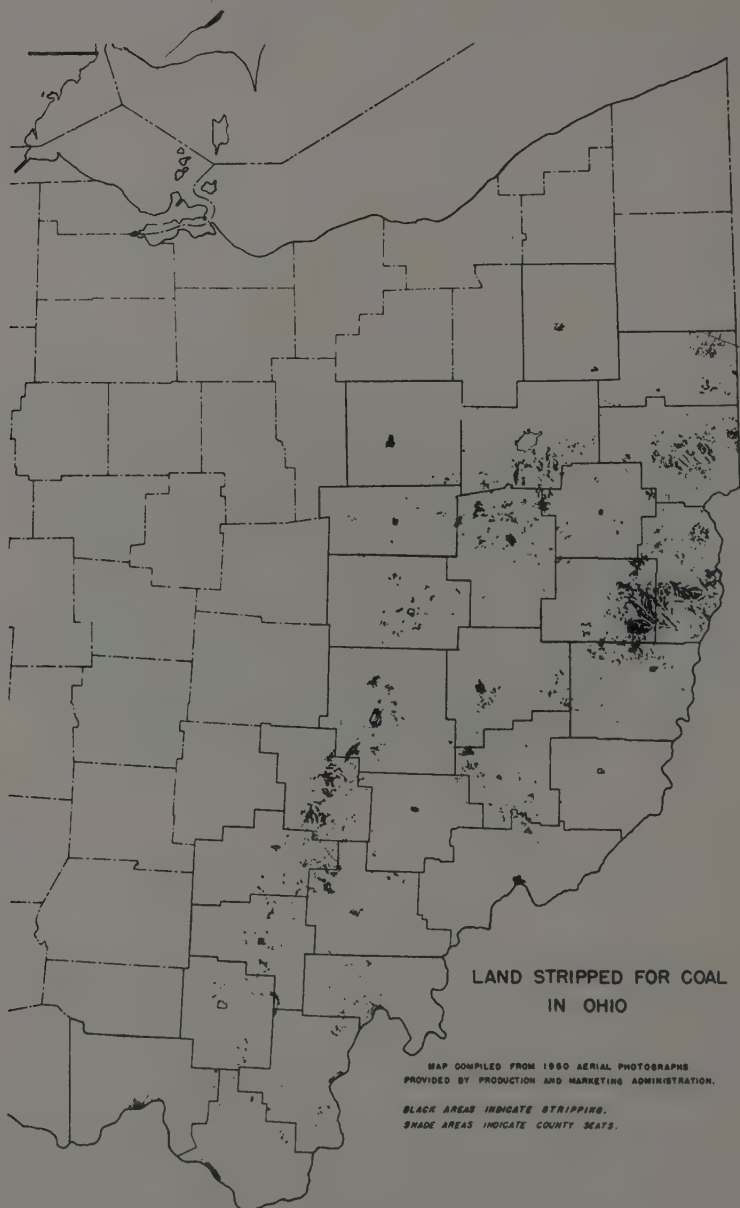


FIGURE 3.

extremely variable as a result of different stripping methods, rock strata, and depths of cut.

Surface sampling for laboratory study must be done carefully to insure significant results; it has been found that composite samples consisting of at least eight subsamples from each area visibly different in color, texture, and mineral content will provide satisfactory material for further study in the laboratory and greenhouse.

In order to obtain the basic information desired, research is being directed along several lines: chemical studies of the mineral elements in the spoil material; chemical analysis of the plants grown on spoils; trial of new plant species for use on the various spoil types; treatment of spoil materials with limestone and fertilizers to promote plant establishment and growth; and observations of the rock strata exposed in the highwall of the final cut.

Spectrographic techniques are being perfected to facilitate the chemical studies of spoils and plant materials. Preliminary investigation has shown that high acidity of many spoil types is accompanied by relatively high solubility of elements such as iron, aluminum, manganese, copper, cobalt, zinc, lead, and nickel. Some of these are essential in trace amounts for plant growth but toxic at higher concentrations. When acid spoils are permitted to remain exposed until the acidity has been reduced by natural weathering and leaching, these desirable elements are lost. On the other hand, application of limestone both reduces the acidity and precipitates the trace elements, thus conserving them for future use by plants.

Greenhouse studies are being conducted to complement the direct chemical investigations of spoil materials. New species of forage plants can be more economically tried in small scale greenhouse plantings than in the field; successful growth there will be followed by more extensive field trials. Chemical analysis of plants grown under controlled greenhouse conditions will reveal the natural availability of nutrient elements and show the results of soil treatments with limestone and fertilizers.

In order to obtain basic criteria for classifying spoil types, observations are being made on the rock strata disturbed in stripping. These observations are supplemental to those made and reported by the Central States Forest Experiment Station. The newly stripped spoil material alone cannot be used readily for complete identification since its properties such as texture, reaction, and chemical and physical composition undergo rapid changes upon exposure to weathering. Observations of thickness and type of rock strata such as sandstones, shales, and limestone together with records of the ultimate spoil properties will eventually be used to guide reclamation of new spoils.

Stripping in the State of Ohio is proceeding at a rate of about 6,000 acres per year, with a total of about 76,000 acres affected at the start of 1951. Approximately three-quarters of that area was stripped before the first reclamation law and will remain untouched except for the land voluntarily reclaimed by the coal operators. All land affected by stripping subsequent to 1947 will be reclaimed under provisions of Ohio law. The Ohio Agricultural Experiment Station is carrying out research to help the stripmine industry fulfill its reclamation obligations to the people of Ohio.

#### LITERATURE CITED

- Dean, F. W. 1925. The reclamation of stripped coal lands. *Jour. Forestry*, 23: 677-682.  
Limstrom, G. A., and R. W. Merz. 1949. Rehabilitation of lands stripped for coal in Ohio. Central States Forest Experiment Station Tech Paper 113: 41 pp.  
Moessner, K. E., and C. E. Jensen. 1951. Timber cruising on aerial photos. Central States Forest Experiment Station Tech. Paper 126: 27 pp.

# A SYSTEMATIC STUDY OF THE MAIN ARTERIES IN THE REGION OF THE HEART—AVES XX

## CAPRIMULGIFORMES, PART 1<sup>1</sup>

FRED H. GLENNY

*Department of Anatomy, The Ohio State University, Columbus 10*

Studies on 12 species of Caprimulgiformes, shows the basic arterial arrangement-pattern in the neck and thorax to be that referred to as bicarotid-normales. The laevo-carotid variation was observed, however, in representatives of two families within the order. Furthermore, an evolutionary tendency sometimes observed in a few other orders of birds was noted in the different families of this order. This characteristic tendency is the rather singular lateral migration of the sterno-clavicular or coracoid arteries from a normal position on the subclavian between the common carotid and axillary arteries to one on the pectoral stem just lateral to the axillary and medial to the internal mammary or intercostal artery.

The following observations characterize the materials studied.

### STEATORNITHIDAE:

*Steatornis caripensis* Humboldt (USNM #18308): bicarotid; both ligamentum aortae and ligamentum botalli present; coracoid arises from subclavian medial to origin of axillary; ductus shawi sends branches to oesophagus and trachea as well as posteriorly to bronchi and connective tissues of the thorax; common carotid then sends off a short thyroid artery before dividing to form a superficial cervical (ascending oesophageal on the right side), vertebral, and internal carotid (trunk) artery.

Garrod (1873) observed that both carotids are present in *Steatornis caripensis*.

### PODARGIDAE:

Laevo-carotidinae; ligamentum aortae present; ligamentum botalli reduced to a linea or entirely lacking; coracoid opposite or just lateral to axillary; right common carotid reduced giving rise to an ascending oesophageal artery in addition to the normal superficial cervical and finally the vertebral artery; left carotid divides to form the superficial cervical, vertebral, and internal carotid (trunk) arteries; ductus shawi and thyroid artery arise as branches of both left and right carotids.

*Podargus strigoides strigoides* (Latham) (USNM #19361): the coracoids are opposite the axillaries.

*Batrachostomus hodgsoni indochinae* Stresemann (USNM #321751): the coracoids are just lateral to the axillaries.

### NYCTIBIDAE:

*Nyctibius griseus* (Gmelin) (USNM #346233): laevo-carotidinae; ligamentum aortae present; coracoid lateral to axillary; ductus shawi prominent; common carotid divides into superficial cervical and vertebral arteries (right side) and superficial cervical, vertebral and internal carotid (trunk) arteries after giving off the thyroid artery.

### CAPRIMULGIDAE:

Bicarotid normales; ligamentum aortae present; ligamentum botalli present and reduced or lacking; coracoids medial or lateral to axillary; ductus shawi and thyroid artery arise as branches of carotid before it divides to form the superficial cervical, vertebral, and internal carotid (trunk) arteries.

<sup>1</sup>Contribution of Blue Sea Lake Biological Laboratory, Messines, Quebec.

Coracoid artery medial to axillary artery:

*Chordeiles virginianus* = *Chordeiles minor minor* (Forster), *Podager nacunda nacunda* (Vieillot), *Nyctidromus albigollis albigollis* (Gmelin), *Scotornis fossii fossii* (Hartlaub), and *Hydropsalis brasiliensis furcifera* (Vieillot).

Coracoid artery opposite or just lateral to axillary artery: *Chordeiles minor vicinus* Riley.

Coracoid artery lateral to axillary artery:

*Nyctiprogne latifascia* (USNM #319819) and *Caprimulgus carolinensis* Gmelin.

Garrod (1873) pointed out that *Chordeiles acutipennis texensis* Lawrence and *Caprimulgus europaeus* Linnaeus both present two carotid arteries which enter the hypapophyseal canal.

It may be concluded, from the above observations, that the members of this order and especially the families within the order are undergoing noticeable anatomical evolution especially with respect to the arrangement of arteries in the neck and thorax. Such major differences as are herein noted may have some taxonomic significance.

The writer is indebted to Dr. Herbert Friedmann, U. S. National Museum, for making available most of the materials used in this study.

#### REFERENCE

Garrod, A. H. 1873. On the carotid arteries in birds. Proc. Zoo. Soc., London, pp. 457-472.

**Europe.** Samuel Van Valkenburg and Colbert C. Held. John Wiley & Sons, Inc., New York. Second edition, 1952. xiv+826 pp. \$7.50.

This new edition of the first issue published in 1935 by the senior author and Ellsworth Huntington, follows essentially the original pattern. In some respects it has been simplified through the removal of part of the geological and geomorphological material and the placing of emphasis upon the humanistic aspects of Europe's problems. Still more of the technical phases could be withdrawn without detracting from its usefulness, inasmuch as most of the students taking geography courses do not specialize in the field and do not take a course in geology as prerequisite to regional courses.

The treatment of Europe as a whole first, followed by consideration of individual countries, as did the earlier volume, should satisfy both those who like to deal with a continent exclusively from the regional point of view and those who recognize that the partition of the area into sovereign states is a reality which should not be ignored.

Statistical data, subject to quick change in an unstable world, have been reasonably well eliminated from the body of the book and thereby improved its readability. Captions associated with photographs might well be more interpretative and many of the so-called maps could be converted to true maps by the introduction of meridians and parallels. It is unfortunate that American geographers increasingly omit these indispensable characteristics of maps.

EUGENE VAN CLEEF.

**Ultraviolet Radiation.** Lewis R. Koller. John Wiley and Sons, Inc., New York, 1952. ix+270 pp. \$6.50.

This book is written for the person who will use ultraviolet radiation as a tool, rather than for the specialist who is thoroughly familiar with the nature of this short-wave radiation and its applications.

The book should be especially helpful to the medical man by providing a background for an understanding of his use of ultraviolet radiation. For example, after reading the book, he should know whether radiation of wavelength longer or shorter than 2800 Angstroms will be better for accomplishing his purpose. Furthermore, he will know whether a high pressure or low pressure mercury arc will be better.

The physicist who reads the book will find little that is said incorrectly or loosely, and will find descriptions of many applications which emphasize how powerful a tool it can be when used properly.

Separate chapters deal with: arcs, the principle source of ultraviolet; incandescent bodies as weak, but convenient, sources; the sun as a source; transmission; reflection; and detectors of this radiation. Also, there is a chapter in which many interesting applications are discussed. The text is documented excellently, there being 77 tables and 148 figures. These tables, although not intended to be complete, make the book of some use for reference purposes.

The style makes for easy reading. The author has used very few words that are unfamiliar to any reader. While all may read it, this reviewer would be especially pleased to see it on the required list of reading for potential medical men.

ROBERT A. OETJEN.

## CAVES IN THE LAKE ERIE ISLANDS

JAMES L. VERBER AND DAVID H. STANSBERRY

*The F. T. Stone Institute of Hydrobiology, The Ohio State University, Put-in-Bay, Ohio*

The origin and historical background of the South Bass Island caves have placed them among the most interesting and controversial caves known. The first available information on the caves was by Newberry (1874) when he described the surface of the island as having depressions: ". . . which are nothing else than caves of which the roofs have fallen in . . ."

Mosely (1898) and Gilbert (1898) recorded that the water found in the caves fluctuates with the lake level, Newberry recorded this fact for Perry's cave. Although Newberry speculated as to how the caves were formed, he did not leave the impression that they were of the solution type. While most of the caves common to the limestone and dolomite bedrock of Ohio are of the familiar solution type, the caves of the Islands are apparently due to collapse. It remained for Kraus (1905) to give the first theory on the formation of the caves. Kraus theorized and Cottingham (1919) agreed that the caves were produced by the expansion of anhydrite into gypsum upon coming into contact with the water. Later White (1926) doubted Kraus' theory of formation because of the lack of gypsum in the Put-in-Bay dolomite. Langlois (1951) reviewed the historical background of some of the caves and described several new ones.

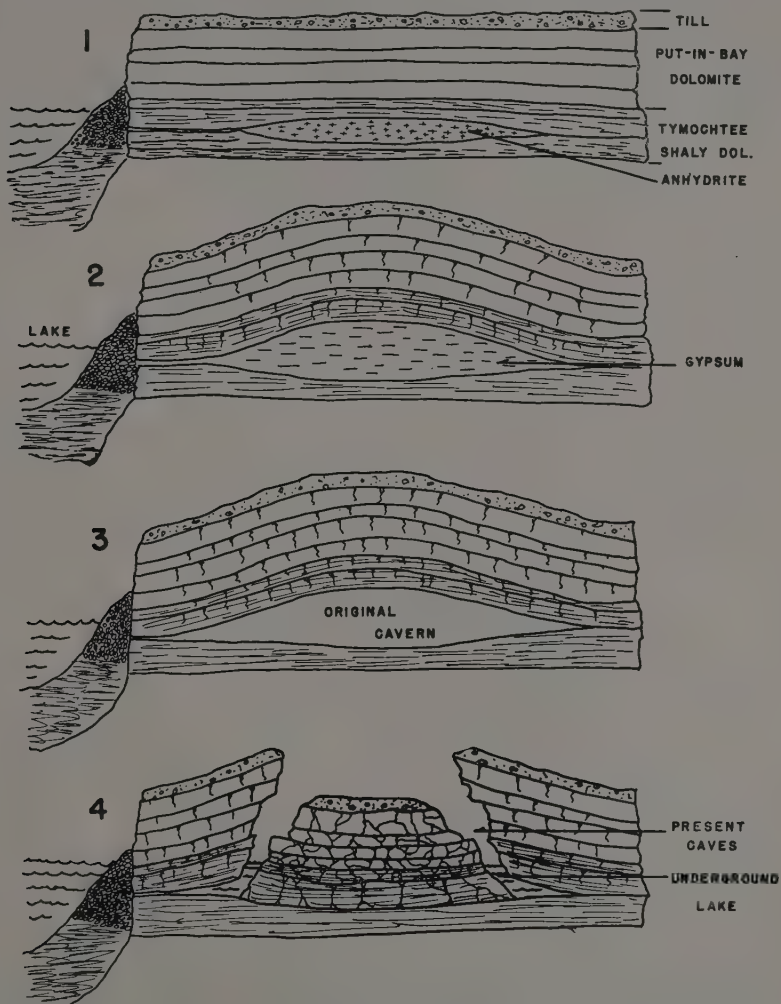
### THEORY OF FORMATION OF THE CAVES

The caves on Put-in-Bay are usually crescent shaped and sloping approximately 30 degrees with the surface of the ground. In some caves, as Victory cave, the slope may be as great as 60°. One cave, Perry's, has not completely collapsed and is oval shaped. The sides, however, dip down and away from the center of the dome showing that partial collapse has taken place. Kraus' theory of anhydrite into gypsum is not invalidated by White. White rightly questioned the source of gypsum to produce the caverns, as none is found in the Put-in-Bay dolomite. The Tymochtee shaly dolomite which underlies the Put-in-Bay dolomite outcrops on the west shore of South Bass Island, some thirty feet from the top of the exposed Put-in-Bay (Carmen, 1947). Newberry (1874) states that anchors of vessels in the South Channel frequently drag up masses of gypsum from the lake bottom. Kraus also mentioned that gypsum was found in alternate layers at a depth of 100 feet on the southwest part of the island. The formation of the caves is not due to the gypsum in the Put-in-Bay, but in the Tymochtee.

The tilting of the rock strata during the upheaval of the Cincinnati anticline caused the bedrock to be weakened and jointed (Cook, 1925). The weakening and jointing of the bed rock provided easy access for water to come in contact with the anhydrite. Earlier reports of cave water oscillating with the lake level were confirmed by means of a portable water level recorder placed in Kindt's I cave. The cave water lags about three hours behind the lake oscillation. Water samples were taken and compared to the lake water and to deep wells on the island. The total alkalinity of the cave water has doubled when it is compared to lake water, but only half that of the three wells tested. The seepage of lake water is not direct into the caves, but through well filtered rock layers (table 1).

Water seepage into the anhydrite lenses could be from three possible sources: rain, pre-glacial rivers, or lake water. With the jointing of the rock layers during the Cincinnati anticline it is possible that enough rain water could have been

filtered through to reach the anhydrite lense. This theory is doubted because evidence shows that only the upper portions of the known caves are wet and the



#### EXPLANATION OF FIGURES

1. An ideal cross-section showing the anhydrite in place.
2. The uplifting of the overlying strata by the anhydrite hydration into gypsum.
3. Cavern left by gypsum going into solution.
4. Collapse of the overlying strata and the formation of new caves around the edges.

lower sections are fairly dry. The travertine is also much thicker in the upper portions of the caves as compared to the deeper parts. Pre-glacial rivers were known to exist in the island regions and could have supplied ample water or water

could have been supplied from lakes formed during the glacial period. The fact that several caves have large stalactites several feet under the surface of the water may well indicate that the caves were formed when the water was at a much lower level, possible during interglacial periods. According to Mosely (1898) this indicated that the islands were sinking, he computed the rate at eight to nine inches per century. It may be both. The hydration of the anhydrite into gypsum produced the doming of the overlying strata (figure 2). According to Kraus the expansion of anhydrite to gypsum is between 33 to 63 percent. This increase in

TABLE 1

*Total alkalinity of water from Kindt's I cave compared to water from the open lake and three wells.*

| Water Source     | Total Alkalinity (ppm) |
|------------------|------------------------|
| Kindt's cave I.  | 180                    |
| Lake Water       | 80-90                  |
| Wells (3 tested) | 270-360                |

volume, calculated at one ton per square inch for the lower figure, produced an elliptical dome. The force exerted by the expansion probably produced the doming of the Put-in-Bay dolomite which is so noticeable on the island. The gypsum was then dissolved and carried away in solution leaving a large subterranean cave (figure 3). The collapse of the dome into the original cavern, figure 4, left crescent shaped caves at the edges. The collapse or faulting of the dome may have been from rain water weakening the joints with some solution taking place or

TABLE 2

*Estimated size and height of seven caves that have collapsed compared to Perry's cave still in existence.*

| Cave                   | Approximate Diameter in feet | Estimated Height of Dome in feet | Depression Below Rim in feet |
|------------------------|------------------------------|----------------------------------|------------------------------|
| Kindt's (3 caves)      | 300 x 250                    | 12-13                            | 6                            |
| Zura's (3 caves)       | 650 x 400                    | 14-15                            | 7                            |
| Cedar Forest (1 cave)  | 200 x 200                    | 14-15                            | 7                            |
| Cedar Forest (3 caves) | 75 x 200                     | 20                               | 10                           |
| Brown's (3 caves)      | 200 x 200                    | 18                               | 9                            |
| Duff's (2 caves)       | 75 x 150                     | 16                               | 8                            |
| Coil's (1 cave)        | 75 x 100                     | 10-11                            | 5                            |
| Perry's (in existence) | 165 x 200                    | 9                                | —                            |

from the sheer weight of the overlying strata already weakened by the expansion. Unsupported arches of 60°, as in Victory cave, are extremely weak and the rocks are fractured. If the caves were formed pre-glacially the weight of the ice sheet could have produced the collapse of all the domes. The fact that Perry's cave has not fallen in tends to disprove the theory. It is possible that some of the caves were formed during the post-glacial periods. It appears, however, that most of the present caves are very young.

The caves on South Bass Island are not part of the original cavern but the edges of the collapsed sections, having water at the lower portions. The presence of elliptical depressions with crescent shaped caves at the edges indicates that

there was a dome which had caved in. The estimated height and size of the original dome as deduced from surface features is shown in table 2.

At present there are over 30 known caves of the Put-in-Bay type which have or formerly had openings. Surface indications show that there are again that many yet to be opened. Victory cave was recently opened, after being sealed for almost 20 years, by Mr. A. Kindt and son Eugene. One cave on Green Island, discovered by Mr. Wm. Coil in 1951, is definitely of the Put-in-Bay type. The cave has very little travertine, and the floor is fairly flat. The roof slopes the same as the other caves, and it is the typical crescent shaped cave. Coil's cave does not have water, and it appears to be very close to the top of the Tymochtee. The roof of the cave appears to be freshly fractured and does not have stalactites.

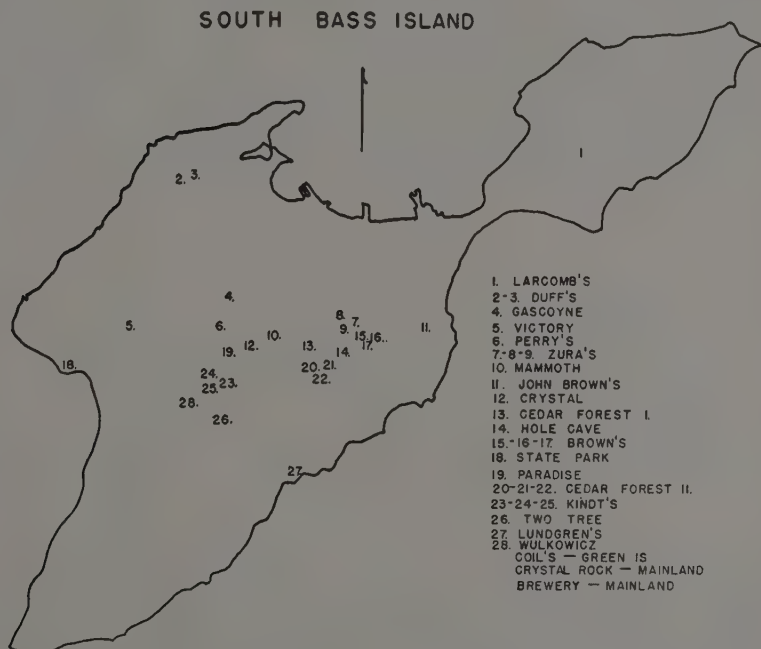


FIGURE 5. Map showing the location of the known caves on South Bass Island.

On the mainland two caves appear to be of this type, Crystal rock cave and Brewery cave, both in the Put-in-Bay dolomite and first described by White (1926). White mentions that there are other 'sink holes' in the area which may indicate the presence of more caves nearby.

Three caves are open to the public on South Bass Island, Mammoth, Crystal, and Perry's cave. Mammoth cave, formerly called Daussa's was called Danssa's by Kraus. This cave has its dome collapsed but most of the outer edge is passable, making it one of the largest caves on the island. Opposite Mammoth cave is Crystal cave, an extremely large celestite geode, which has crystals measuring 18 inches long. A small, flat floored, cave exists several feet below the present floor of the cave. According to White the cave was discovered in 1891 and was only three feet in height. Over five tons of crystal were removed from the floor and

sold for the manufacture of fireworks, and the floor was then deepened to permit standing room. Undoubtedly the deepening of the floor opened up the lower cave. There appears to be little doubt that Crystal cave is one of the largest geodes known to exist. Perry's cave is the only opened cave on the island where the dome has not completely collapsed. The cavern is oval shaped and the floor and roof meet at the edges. With the single exception of Crystal cave, all the other caves are of the Put-in-Bay type. No caves have been found on the other islands except for Green Island. The other islands do not show surface indications of caverns being present. The Tymochtee shaly dolomite is well over 100 feet from the surface and if caves do exist they would be far underground. On Kelley's Island the Tymochtee is over 350 feet from the surface.

Flora and fauna of the caves appears to be very scant, perhaps due to the lack of intensive biological research in the caves. Many spiders and crickets are found near the entrances and three caves are known to be inhabited by the Little Brown Bat (*Myotis i. lucifugus*), Coil's cave on Green Island had one and Duff's I cave and Victory cave has a nest of over 50. The bats found during the winter of 1953 were predominately males. Bats have been reported from Mammoth cave, but are now kept out. Mr. L. Carrick found animal life in the water of one of the caves which was identified as a Collembolan by Dr. N. W. Britt. Dr. Britt suggested that it may have fallen into the water and thus would be an accidental find.

#### SUMMARY

1. Kraus's theory of anhydrite into gypsum appears to be correct. The source of the gypsum, however, is in the Tymochtee shaly dolomite which underlies the Put-in-Bay dolomite.

2. Water seepage from the lake is not direct but well filtered. The water in the caves lags about three hours behind the primary lake oscillation.

3. Surface features of elliptical depressions with caves at the edges shows that collapse has taken place. From these depressions the size of the former caves has been estimated.

4. Flora and fauna of the caves appears to be very scant, the Little Brown Bat, spiders, crickets and one Collembolan make up the major part of the fauna.

#### LITERATURE CITED

- Carman, J. E. 1947. The geologic interpretation of scenic features in Ohio. Ohio Jour. Sci., 46: 241-283.
- Cook, C. W. 1925. The influence of joints in the formation of the islands of western end of Lake Erie. Papers Mich. Acad. Sci. Arts & Letters, 5: 243-251.
- Cottingham, K. 1919. The origin of the caves of Put-in-Bay, Ohio. Ohio Jour. Sci., 20: 38-42.
- Gilbert, G. K. 1898. Recent Earth Movement in the Great Lakes region. U. S. Geol. Surv. 18th Annual Rept. 1896-97. 597-647.
- Kraus, E. H. 1905. On the origin of Put-in-Bay caves. Amer. Geol., 35: 167-171.
- Langlois, T. H. 1951. The caves on South Bass Island. Inland Seas, Summer.
- Mosely, L. 1898. Lake Erie Enlarging. Lake Side Mag., 1: 14-20.
- Newberry, J. S. 1874. Report on the geology of Erie County and the Islands. Geol. Surv. Ohio, 2(1): 183-205.
- Ryall, L. J. 1913. Sketches and stories of the Lake Erie Islands. The Amer. Publishing Co., Norwalk, Ohio. 546 pp.
- White, G. W. 1926. The limestone caves and caverns of Ohio. Ohio Jour. Sci., 26: 79-86.

## EFFECT OF SOFT X-RAYS ON AUREOMYCIN

FRED A. BLANCHARD,<sup>1</sup> VIOLET M. DILLER, AND H. KERSTEN

*Department of Physics, University of Cincinnati, Cincinnati 21, Ohio*

In view of the consideration which has been given to the use of aureomycin in cases of radiation injury produced by atomic bombs (Cronkite, 1951), it is of interest to investigate the effects radiations might have on this substance. Such studies have been made on other compounds (O'Meara, 1952). This paper considers the effects of irradiation of aureomycin with soft x-rays of high intensity.

### MATERIALS AND METHODS

Aureomycin hydrochloride (Lederle) was used in three states: crystalline, aqueous solution, and frozen aqueous solution. Twenty-five mg of the solid or 2 ml of a 100  $\mu\text{g}/\text{ml}$  solution were placed in a Lucite (DuPont) cup 17 mm in diameter and 6 mm deep (with the solution protruding from the cup with a convex meniscus). When frozen samples were desired, this cup containing the solution was placed in a recess in the top of a brass rod whose lower end was immersed in a solid  $\text{CO}_2$ -acetone bath. For such samples, this freezing arrangement was maintained during irradiations.

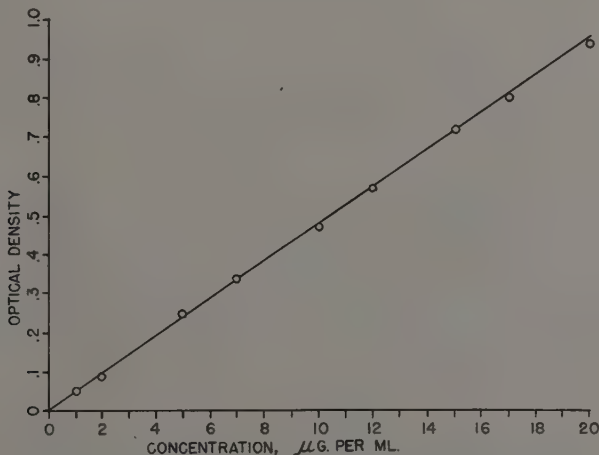


FIGURE 1. Relation of optical density to concentration of aureomycin solutions at 367  $m\mu$ .

During the irradiation the sample cup was placed 2 to 3 mm below the beryllium window of a Machlett AEG-50-T x-ray tube (Machlett Laboratories, Inc., Springfield, Connecticut). The tube was operated at 35 kv and 10 ma. Data concerning the characteristics of this tube as given by Rogers (1947) indicate that the irradiation should have had a wave-length range of 0.4 to 4.4  $\text{\AA}$  with a peak at approximately 1.5  $\text{\AA}$  and an intensity at the sample of approximately 250,000 r/min.

<sup>1</sup>Present address: Spectroscopy Laboratory, Dow Chemical Co., Midland, Michigan.

Irradiation periods of up to 15 minutes for the solutions and 20 minutes for the frozen solutions were used. A single experiment was made on dry crystals with a 15-minute irradiation.

Bioassays to determine the strength of irradiated samples and controls were made by the serial dilution method of Dornbush and Pelcak (1948) using *Bacillus cereus* No.5 as the test organism.

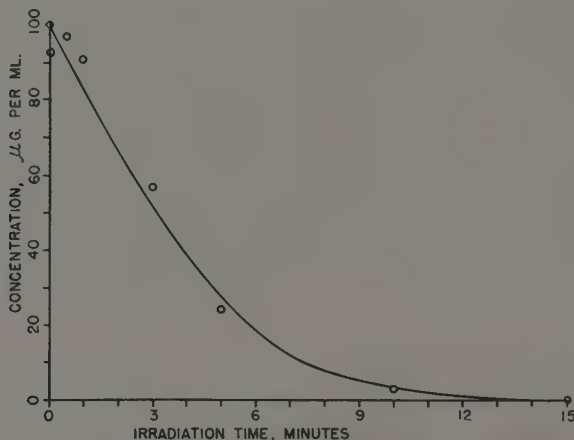


FIGURE 2. Concentration of x-rayed aureomycin solutions as determined by bioassays. Initial concentration before irradiation was 100  $\mu\text{g/ml}$  for all solutions.

The optical density of irradiated and control solutions was measured with a Beckman Model DU Spectrophotometer at a number of wavelengths in the ultra-violet. As a reference for concentration changes, measurements of optical density of various dilutions of a 20  $\mu\text{g/ml}$  solution of aureomycin were made at 367  $m\mu$  (fig. 1). The working range of the Beckman necessitated dilution of the 100  $\mu\text{g}$  per ml standards to 10  $\mu\text{g}$  per ml. An attempt was made to dilute irradiated samples to 10  $\mu\text{g}$  per ml before determining optical density. This was done by assuming that they had deteriorated to the values indicated by the bioassays.

TABLE 1

*Effect of soft x-rays on frozen aqueous solutions of aureomycin*

| Number of experiments | Irradiation time in minutes | Final concentration, average value in $\mu\text{g/ml}$ |
|-----------------------|-----------------------------|--------------------------------------------------------|
| 1                     | 0                           | 100                                                    |
| 1                     | 1                           | 95                                                     |
| 1                     | 3                           | 55                                                     |
| 2                     | 5                           | 25                                                     |
| 3                     | 10                          | 5                                                      |
| 1                     | 15                          | 120                                                    |
| 1                     | 20                          | 100                                                    |

Initial concentration of all solutions, 100  $\mu\text{g/ml}$

## RESULTS AND DISCUSSION

Biological activity of the aureomycin solutions decreased markedly with increasing irradiation time. At 3-4 minutes it had fallen to about 50 per cent of its initial value of 100  $\mu\text{g}$  per ml (fig. 2). On the other hand, there was no measured activity decrease in the crystalline aureomycin and no clearcut decrease in the frozen solutions (table 1). Radiation sensitivity of substances in dilute aqueous solution and relative insensitivity as a crystalline solid or in frozen aqueous solution has been noted before. A discussion of work on these phenomena is given by O'Meara (1952).

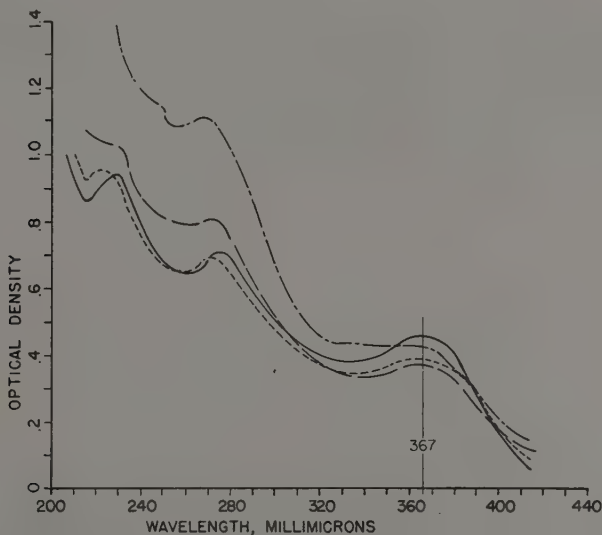


FIGURE 3. Ultraviolet absorption curves of aureomycin solutions showing comparison of control non-irradiated solution with irradiated samples. All solutions at 100  $\mu\text{g}/\text{ml}$  before irradiation.

- Control solution, diluted 1 : 10;
- Irradiated 1 min, diluted 1 : 10;
- - - - - Irradiated 3 min, diluted 1 : 8;
- · - · - Irradiated 5 min, diluted 1 : 6.

Curves prepared from the ultraviolet data are shown in figure 3. Interpolation of optical density values of irradiated samples at 367  $\text{m}\mu$  in figure 1 yields concentrations in  $\mu\text{g}$  per ml of 98, 83, 65, and 55 respectively for control, 1-minute, 3-minute, and 5-minute irradiations as compared with 100, 91, 57, and 24 for the bioassays.

Immediately after irradiation there was a noticeable darkening of the yellow color of treated solutions. This was distinguishable, when compared with controls for irradiation times as short as  $\frac{1}{2}$  minute but was especially marked for longer irradiation times. Solutions continued to darken for hours after being exposed to the x-rays.

The pH of a solution before a 5-minute irradiation was 3.4. The same value was obtained on the day following irradiation for it and a non-irradiated control solution.

## SUMMARY

Aqueous solutions, frozen solutions, and dry crystalline Aureomycin hydrochloride (Lederle) were subjected to doses of soft x-rays at about 250,000 r units per minute. A bioassay was then used to determine whether there had been any change in the inhibiting action of the treated material on *Bacillus cereus* No. 5. The solution (100  $\mu$ g per ml initially) lost half its strength after 3 to 4 minutes irradiation. Deterioration was confirmed with UV curves. There was no measurable change in the dry crystals after 15 minutes irradiation or in the frozen solutions after 20 minutes irradiation.

## LITERATURE CITED

- Cronkite, E. P. 1951. The diagnosis, prognosis, and treatment of radiation injuries produced by atomic bombs. *Radiology*, 56: 661-669.  
Dornbush, A. C., and E. J. Pelcak. 1948. The determination of aureomycin in serum and other body fluids. *Annals N. Y. Acad. Sci.*, 51: 218-220.  
O'Meara, J. P. 1952. Radiation chemistry and sterilization of biological materials by ionizing radiations. *Nucleonics*, 10: 19-23.  
Rogers, T. H. 1947. High-intensity radiation from beryllium-window X-ray tubes. *Radiology*, 48: 594-602.

---

**Earth Song—A Prologue to History.** Charles L. Camp. University of California Press Berkeley and Los Angeles, 1952. 127 pp. \$5.00.

The sober matter-of-factness of most textbooks on historical geology and paleontology sometimes makes us wonder if their story is worth telling, if it can awaken any interest in their readers. Perhaps it is necessary, for pedagogic purposes, to write in a minor key, or perhaps the fashion of dignified restraint has become so ingrained in textbook authors that lyrical expression is unthinkable. Still, paleontologists are far from lacking in enthusiasm, nor are they a pedestrian, inarticulate lot. Somehow, though, the enthusiasm seldom emerges in their writings and the Hugh Millers, enraptured before a faultlessly preserved fossil fish, are rare in this twentieth century.

Charles L. Camp is one of the few who have tossed their academic cap over the windmills to write about fossils in poetic language. Such titles as "Tale of the Sea Rocks," "Black Death," and "Before the Mayflower" would have been rendered by a less imaginative writer as "Fossiliferous Sediments," "Fauna of the Tar Pits," and "Folsom Man and his Artifacts." It is not only the titles that bear the poetic touch. The entire text is written with a sense of wonder that seems to recapture the pristine awe of the pioneers of paleontology, who delighted not in reaching the ends of the Earth but the ends of time itself, seeking the strange creatures that first swam the seas. In this book, the majestic procession of life, from the algae of the pre-Cambrian to Man himself, passes in orderly review, with a realism that is refreshing after the over-sober presentation of paleontologic literature. If the story overemphasizes California life and events, that seems a small price to pay for the fresh and vivid way of telling the story.

AURELE LA ROCQUE.

# A SYSTEMATIC STUDY OF THE MAIN ARTERIES IN THE REGION OF THE HEART—AVES XIX

## APODIFORMES, PART 1<sup>1</sup>

FRED H. GLENNY

*Department of Anatomy, The Ohio State University, Columbus 10*

Recent studies on 39 species of Apodiformes, with respect to the arterial arrangement-pattern in the neck and thorax tend to substantiate the observations of Garrod (1873) on members of this order of birds. Garrod showed that while the left carotid alone persists as the chief cephalic supply in most of the Apodiformes a few species present the bicarotid condition commonly found in most orders of birds.

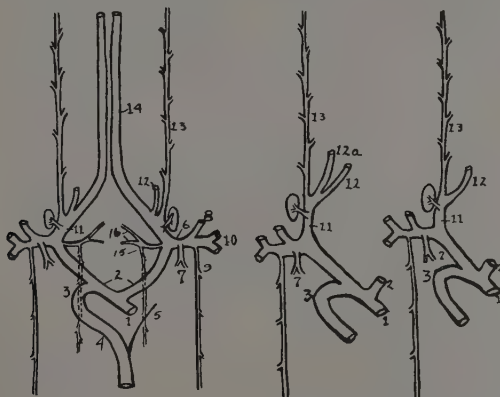


Fig. 1

Fig. 2

Fig. 3

FIGURES 1-3. Diagrammatic representation of the main arteries in the neck and thorax of: 1. *Nephoecetes* and *Streptoprocne*. 2. Right side: *Aëronautes*. 3. Right side: *Apus*.

### KEY TO ABBREVIATIONS

- |                                    |                                             |
|------------------------------------|---------------------------------------------|
| 1. aortic root                     | 10. pectoralis                              |
| 2. innominate artery               | 11. common carotid                          |
| 3. right systemic arch             | 12. vertebral                               |
| 4. right radix aortae              | 12a. accessory vertebral                    |
| 5. ligamentum aortae               | 13. superficial cervical (comes nervi vagi) |
| 6. subclavian artery               | 14. internal carotid (trunk)                |
| 7. coracoid or sterno-clavicular   | 15. ductus shawi                            |
| 8. axillary                        | 16. tracheal.                               |
| 9. intercostal or internal mammary |                                             |

In the Apodiformes, the coracoid or sterno-clavicular artery arises as the first branch of the subclavian which then gives rise to the pectoral branch as the subclavian continues as the axillary artery. The first branch of the pectoral stem is the intercostal or internal mammary artery. The common carotid then sends

<sup>1</sup>Contribution of Blue Sea Lake Biological Laboratory, Messines, Quebec.

off a thyroid artery and further divides to form the superficial cervical (comes nervi vagi), vertebral, and carotid trunk artery. In most Apodiformes, the left carotid alone enters the hypapophysial canal. In one notable instance, the basal portion of the right internal carotid becomes modified as an accessory vertebral artery (fig. 2, 12a). In a few other species, especially of the Apodidae, the bicarotid condition persists in the adult. In the Trochilidae, two coracoid or sterno-clavicular arteries were found to arise from the face of the subclavian before the axillary artery passed anterolaterally to the wing. The ligamentum aortae is present, but unless otherwise noted, the ligamentum botalli is lacking.

## APODIDAE:

- Collocalia inexpectata bartschi* Mearns: laevo-carotidinae.  
*Streptoprocne zonaris pallidifrons* (Hartert): bicarotid.  
*Chaetura pelagica* (Linnaeus): laevo-carotidinae; ascending oesophageal artery arises from common carotid after origin of vertebral on the right side.  
*Nephoecetes niger niger* (Gmelin): bicarotid.  
*Apus andecolus andecolus* (d'Orbigny & Lafresnaye): laevo-carotidinae.  
*Aëronautas saxatalis saxatalis* (Woodhouse) 2 specimens: two right vertebral arteries; laevo-carotidinae.  
*Tachornis phoenicobia phoenicobia* Gosse: laevo-carotidinae.

## HEMIPROCINIDAE:

- Hemiprocne comata major* (Hartert): laevo-carotidinae.

## TROCHILIDAE:

No major differences in arterial pattern are found in the species listed below. Only apparent differences due to reduction in size of the system and length of vessels may be noted, such "apparent" differences are not real differences and are therefore not mentioned herein. The following species show the same arrangement-pattern for arteries in the neck and thorax.

- Glaucis hirsuta hirsuta* (Gmelin).  
*Phaethornis* sp. (U. S. National Museum #225016).  
*Florisuga mellivora mellivora* (Linnaeus).  
*Anthracothonax dominicus* (Linnaeus).  
*Eulampis jugularis* (Linnaeus).  
*Sericotes holosericeus holosericeus* (Linnaeus).  
*Chrysolampis mosquitus* (Linnaeus).  
*Orthorhynchus cristatus exilis* (Gmelin).  
*Lophornis* sp. (U. S. National Museum #81493).  
*Chlorostilbon canivetti caribaeus* Lawrence.  
*Chlorostilbon ricordii ricordii* (Gervais).  
*Cyananthus latirostris latirostris* Swainson.  
*Thalurania furcata colombica* (Bourcier).  
*Lepidopyga goudoti goudoti* (Bourcier).  
*Hylocharis xantusii* (Lawrence).  
*Hylocharis chrysura* (Shaw).  
*Trochilus polytmus polytmus* Linnaeus.  
*Leucippus fallax fallax* (Bourcier).  
*Amazilia tobaci* (U. S. N. M. #346366) zoo specimen.  
*Amazilia tzacatl tzacatl* (De la Llave).  
*Chalybura buffonii aeneicauda* Lawrence.  
*Oreotrochilus leucopleurus* Gould.  
*Sephanoides fernandensis fernandensis* (King).  
*Sephanoides sephanoides* (Lesson).  
*Sappho sparganura sappho* (Lesson).  
*Helimaster furcifer* (Shaw).  
*Philodice evelynae evelynae* (Bourcier).

*Archilochus colubris* (Linnaeus).

*Mellisuga minima vieillot* (Shaw).

*Stellula calliope calliope* (Gould).

*Selasphorus platycercus platycercus* (Swainson).

Garrod (1873) pointed out that the left carotid alone is present in the following species:

*Patagona gigas* (Vieillot).

*Chlorolampis osberti* (Probably = *Chlorostilbon canivetti osberti*).

*Cypselus apus* = *Apus apus apus* (Linnaeus).

*Cypselus alpinus* (Possibly = *Apus melba*).

*Chetura vauri* = *Chaetura vauri* (J. K. Townsend).

*Chetura spinicauda* = *Chaetura s. spinicauda* (Temminck).

*Chetura caudacuta* = *Hirund-apus caudacutus* (Latham).

*Dendrochelidon coronata* (Possibly = *Hemiprocne longipennis coronata*), while both carotids are present in:

*Cypseloides fumigatus* (Streubel).

In the Trochilidae there is a very high degree of uniformity in the arterial arrangement-pattern, while in the Apodidae there is a strong tendency for the laevo-carotid condition but with some evidence that this order of birds had their origin perhaps somewhat more recently from a bicarotid stock of birds.

The writer wishes to express his gratitude to Dr. Herbert Friedmann for making available the materials used in this study.

#### REFERENCE

Garrod, A. H. 1873. On the carotid arteries in birds. London, Proc. Zool. Soc., 457-472.

---

**Understanding Heredity.** Richard B. Goldschmidt. John Wiley & Sons, Inc., New York. 1952. ix+228 pp. \$3.75.

In this book Professor Goldschmidt has set out to write a short and easily readable account of the basic facts of genetics, which would be useful as a text for an elementary course in genetics for students not specializing in biology, and could also be read with understanding by the layman. The result fulfills these objectives admirably. The presentation is simple, clear, and well balanced.

There are a few minor faults. Although it is emphasized that experimentally determined Mendelian ratios are subject to sampling error, cross-over frequencies are said to be "precisely" repeatable in experiments made under identical conditions. Figure 17E on page 50 is labeled a maturation division but appears rather to be a pollen grain mitosis. In addition, the discussion of the general applicability of Mendel's laws on page 66 may lead to some misconceptions. Goldschmidt qualifies the term "Mendelize" to include "all the more or less complicated behavior of the genetic elements which can be derived from the simple case" and then goes on to say that in this sense all inheritable characteristics can be said to "Mendelize." However, the nature and importance of the qualifications are not likely to be appreciated by the neophyte who may then expect to find simple modes of inheritance wherever he looks for them. It would be less misleading to say that it is the genes which Mendelize, and that a trait will appear to do so or not as it is more or less directly determined by a gene.

Simplified explanation of a complicated subject without distortion is in many ways more difficult to accomplish than a more advanced presentation. Professor Goldschmidt has brought unusual skill to the task and has written a book that should make the subject matter of genetics available to any reasonably interested and intelligent person.

MARGARET C. GREEN.

# THE ATTEMPTED DEHYDROGENATION OF 3,4-DISUBSTITUTED THIOLANES<sup>1</sup>

ALVIN I. KOSAK<sup>2</sup> AND ROBERT L. HOLBROOK<sup>2</sup>

*Department of Chemistry, The University of Cincinnati, Cincinnati 21, Ohio*

We have subjected 3,4-thiolanediol and its diester and diethyl ether derivatives to dehydrogenation procedures in an attempt to prepare the corresponding thiophene analogs. Thiolane itself has been dehydrogenated to thiophene in 32% yield using platinized charcoal at 400°, and in 18% yield with nickel sulfide on alumina at 350° (Jurjew and Borissow, 1936); in each case the remainder of the material was converted to hydrogen, hydrogen sulfide, olefins, and alkanes. Passage of thiolane vapors through a "red-hot" glass tube is reported to give traces of thiophene (Grischkewitsch-Trochimowski, 1916). The syntheses of thiophene and its homologs from hydrocarbons and sulfur probably involve thiolane intermediates which subsequently undergo dehydrogenation (Friedmann, 1951, 1951), and sulfur and thiolane under pressure do give small yields of thiophene (Friedmann, 1951b).

DL-1,4-Dichloro-2,3-dihydroxybutane (Owen, 1949) was cyclized to 3,4-dihydroxythiolane (Kilmer et al., 1942) with sodium sulfide. The latter was converted to the diacetate and dibenzoate esters. The diacetate was also prepared by cyclizing DL-1,4-dichloro-2,3-diacetoxybutane (Owen, 1949). 3,4-Diethoxythiolane was prepared by a slight modification of the method of Patterson and Karabinos (1946).

The four substituted thiolanes were heated with sulfur under dehydrogenating conditions with and without solvents. When short reaction times were employed, most of the starting material was recovered unchanged. Under more vigorous conditions decomposition occurred with the concomitant evolution of hydrogen sulfide. Similar results were obtained using platinum on charcoal as the dehydrogenating agent. Neither of the diesters was attacked by choranyl.

In a series of vapor runs, solutions of sulfur and the dibenzoate or the ether were passed under nitrogen pressure through a tube packed with "non-catalytic" fused alumina balls and maintained at temperatures varying from 450-525°. Decomposition occurred in every case. Attempts to split out two molecules of acid from the diester by pyrolysis in the absence of sulfur (Morell et al., 1945; Schlechter et al., 1945) were also unsuccessful.

We believe that dehydrogenation took place during these various experiments, and that the substituted thiophenes then decomposed. The instability of 3,4-dihydroxythiophene has been mentioned by Fager (1945) and by Turnbull (1948). The ethoxy, benzoxy, and acetoxy substituents would tend to increase the susceptibility of the thiophene nucleus to degradative attack because of their action in increasing the electron density in the ring.

## EXPERIMENTAL

**3,4-Dihydroxythiolane.**—The chlorination of butadiene (Mislow and Hellman, 1951) yielded *trans*-1,4-dichloro-2-butene in 45% yield (based on butadiene) and

<sup>1</sup>Abstracted from the M.S. thesis of R. L. H., December, 1951. A portion of this material has appeared in Science 0000.

<sup>2</sup>Present addresses: A. I. K., Department of Industrial Medicine, New York University, New York 16; R. L. H., The Mathieson Chemical Corp., Niagara Falls, N. Y.

16% of 1,2-dichloro-3-butene. The former was converted to DL-1,4-dichloro-2,3-dihydroxybutane (56%) (Owen, 1949), and cyclization to the thiolane was effected by adding a solution of 10 g. (0.04 mole) of sodium sulfide nonahydrate in 5 ml of water to a stirred solution of 4 g (0.02 mole) of dichlorodihydroxybutane in 35 ml of water at 60°. After four hours on the steam bath, the solvent was removed *in vacuo* from the acidified reaction mixture, and the residue was extracted repeatedly with hot absolute ethanol. The ethanol was removed and the residue recrystallized from chloroform and then from ethanol giving 1.9 g (64%) of colorless crystals, m.p. 61–62°; literature m.p. 54–58° (Kilmer et al., 1942).

**3,4-Diacetoxythiolane.**-(a) To 2.5 g (0.01 mole) of DL-1,4-dichloro-2,3-diacetoxybutane (Owen, 1949) in 100 ml of ethanol was added a solution of 5 g (0.02 mole) of sodium sulfide nonahydrate in 10 ml of hot ethanol, and the solution was refluxed for five hours. The cooled product was filtered and the filtrate concentrated *in vacuo* to yield a colorless solid which, after recrystallization from petroleum ether (30–60°), gave 1.3 g (64%) of colorless needles, m.p. 42–44°. (b) A mixture of 3.0 g (0.03 mole) of 3,4-dihydroxythiolane, 20.8 g of acetic anhydride, and 2 ml of hydrochloric acid was refluxed for five hours. The solvent was removed and the residue recrystallized from petroleum ether (30–60°) to give 3.7 g (73%) of colorless needles, m.p. 42–44°.

*Anal.* Calcd. for  $C_8H_{12}O_4S$ : C, 47.1; H, 5.9. Found C, 47.2 H, 5.8.

**3,4-Dibenzoxythiolane.**-To a stirred mixture of 2.4 g (0.02 mole) of 3,4-dihydroxythiolane and 2 g (0.05 mole) of sodium hydroxide as a 20% aqueous solution at 5° was slowly added 7 g (0.05 mole) of benzoyl chloride. The mixture was refluxed for four hours, cooled, and the crystalline solid which precipitated was extracted with sodium carbonate solution. Recrystallization from petroleum ether (30–60°) gave 5.0 g (81%) of colorless crystals, m.p. 136–137°.

*Anal.* Calcd. for  $C_{18}H_{16}O_4S$ : C, 65.8; H, 4.8. Found: C, 65.3; H, 4.7.

**3,4-Diethoxythiolane.**-Synthesized by the method of Patterson and Karabinos (1946) in 33% overall yield from butadiene.

#### DEHYDROGENATIONS

**Liquid phase.** The thiolanes were heated with the calculated amount, or a slight excess, of sulfur at temperatures in the range of 120–220° and for periods of time ranging from fifteen minutes to twenty-six hours. Both with and without a solvent (*p*-cymene, naphthalene), hydrogen sulfide was given off and carbonaceous decomposition products were isolated, except in the runs with short reaction times wherein most of the starting material was recovered unchanged. Platinized charcoal (Linstead and Thomas, 1940) and the thiolanes in refluxing naphthalene gave similar results. 3,4-Diacetoxythiolane (1 mole) was recovered unchanged after refluxing with chloranil (2 moles) (Arnold and Collins, 1939) for sixteen hours in benzene. The same result was obtained with the dibenzoxy compound.

**Vapor phase.** An electrically heated galvanized iron pipe, 5 feet long and 1 inch in diameter, was packed with  $\frac{1}{4}$  inch fused alumina balls (Alcoa Tabular Alumina T-162; we wish to thank the Aluminum Company of America for the gift of this material). Photomicrographs of these balls show that the surfaces are not porous; the alumina displays no tendency to adsorb simple hydrocarbons or hydrogen (private communication from Dr. H. E. Hoelscher). Two dropping funnels with pressure equalizer side arms, one funnel for a solution of sulfur and the second for the thiolane solution, were connected to the tube by preheaters. The reactor was also fitted with nitrogen inlet, thermocouple, and receiver and condensing system. A solution of 10 g of the cyclic sulfide (dibenzoxy- or diethoxythiolane) in 100 ml. of *m*-xylene or diphenyl ether was introduced through one preheater during the course of two hours, while a solution of 3.5 g of sulfur in the same solvent was added through the other. The temperature of the reactor

in different runs varied from 455–525°. The approximate nitrogen flow rate varied from 0.1 to 1.5 ft<sup>3</sup>/minute. In each case decomposition occurred, and no organic product other than the solvent could be isolated. Preliminary runs showed that the solvents and sulfur when passed through the tube severally could be recovered quantitatively. Attempts to prepare thiophene itself by pyrolysis of these thiolanes at temperatures up to 585° and at the same reaction times as above were unsuccessful, carbonization of the organic sulfur compound occurring. Deposition of a carbon layer on a fresh charge of alumina balls was observed after only one run.

## REFERENCES

- Arnold, R. T., and C. J. Collins. 1939. The low temperature dehydrogenation of hydroaromatic rings. *Jour. Am. Chem. Soc.*, 61: 1407.
- Fager, E. W. 1945. Some derivatives of 3,4-dihydroxythiophene. *Jour. Am. Chem. Soc.*, 67: 2217.
- Friedmann, W. 1941. Action of sulfur upon hydrocarbons under high pressure. *Refiner Natural Gasoline Mfr.*, 20: 395.
- Friedmann, W. 1951. Dithionethiophanes. *Jour. Inst. Petroleum*, 37: 325; cf. Rasmussen, H. E., R. C. Hansford, and A. N. Sachanen, 1946. Reactions of aliphatic hydrocarbons with sulfur. *Ind. Eng. Chem.*, 38: 376.
- Friedmann, W. 1951b. Dehydrogenation of tetrahydrothiophene. *Jour. Inst. Petroleum*, 37: 239.
- Grischkewitsch-Trochimowski, E. 1916. Sulfides with a 5-membered nucleus. *Jour. Russ. Phys. Chem. Soc.*, 48: 901; the thiophene was not isolated but was presumed to be present since the reaction product gave a positive indophenin test.
- Jurjew, Y. K., and A. E. Borissow. 1936. Catalytic transformations of heterocyclic compounds. *Ber.*, 69: 1395.
- Kilmer, G. W., M. D. Armstrong, G. B. Brown, and V. du Vigneaud. 1942. Synthesis of a 3,4-diaminotetrahydrothiophene and a comparison of its stability with the diaminocarboxylic acid from biotin. *Jour. Biol. Chem.*, 145: 495.
- Linstead, R. P., and S. L. S. Thomas. 1940. Dehydrogenation. *Jour. Chem. Soc.* 1127 (catalyst—d).
- Mislow, K., and H. M. Hellman. 1951. Stereochemistry of 1,4-addition. *Jour. Am. Chem. Soc.*, 73: 244.
- Morell, S. A., H. H. Geller, and E. C. Lathrop. 1945. Conversion of 2,3-butyleneglycol to 1,3-butadiene by pyrolysis of diacetate. *Ind. Eng. Chem.*, 37: 877.
- Owen, L. N. 1949. The dichlorobutanediols. *Jour. Chem. Soc.*, 241.
- Patterson, W. I., and J. V. Karabinos. 1946. Biotin intermediate. U. S. pat. 2,400,436.
- Shlechter, N., D. F. Othmer, and R. Brand. 1945. Pyrolysis of 2,4-butyleneglycol diacetate to butadiene. *Ind. Eng. Chem.*, 37, 905 (1945).
- Turnbull, S. G., Jr. 1948. 3,4-Dihydroxythiophene. U. S. pat. 2,453,103.

---

**College Chemistry—A Systematic Approach.** Harry H. Sisler, Calvin A. VanderWerf, and Arthur W. Davidson. The Macmillan Company, New York. 1953. ix+623 pp. \$5.25.

The text is designed for the use of college students taking a full year of general chemistry. It is very well written and has excellent format. Emphasis is placed on the structural basis of the properties of matter. Theoretical principles are introduced early in the book, and a continuous application of these principles is made to the descriptive chemistry of the metals and nonmetals. The solution of numerical problems is demonstrated well using methods which would provide an understanding of the system considered rather than memorization of formulas. Relevant study question and problems (without answers) follow each chapter. This book is a shorter and more compact volume than the authors' "General Chemistry—A Systematic Approach," but the arrangement and the treatment of the material are very similar. The condensation is accomplished by elimination of much of the historical material, by simplification of the derivations of certain laws, and by pruning of the descriptive matter. The number of illustrations is increased and should aid the student greatly in grasping concepts. The authors' aim, "to assist the teacher in conveying to the student a thorough understanding, based upon a real conceptual picture of the fundamental principles of chemistry," should be realized through the very logical arrangement and systematic treatment of the basic chemical concepts and many chemical facts.

JACK G. CALVERT

# PHOTOSYNTHESIS OF NATURAL COMMUNITIES DOMINATED BY *CLADOPHORA GLOMERATA* AND *ULOTHRIX ZONATA*

GLADYS L. McMILLAN<sup>1</sup> AND JACOB VERDUIN

*Franz Theodore Stone Institute of Hydrobiology, Put-in-Bay, Ohio*

The littoral zone in western Lake Erie is populated by attached filamentous algal communities dominated in summer by *Cladophora glomerata* (L.) Kutz., and in winter by *Ulothrix zonata* (Weber & Mohr) Kutz. During 1950-51 these communities were studied to determine their photosynthetic activity under near-natural conditions. Graphs showing the relationship between photosynthesis and light intensity are reproduced and discussed below. These researches were carried out by the senior author at the Stone Institute of Hydrobiology in partial fulfillment of the requirements for the M. S. degree.

## METHODS

The method used to measure photosynthesis was similar to that used by Verduin (1951) in studies of phytoplankton photosynthesis. Algae were collected from their natural habitat and studied shortly after collection. Small amounts of algae (1-2 gm) were squeezed manually to remove most of the water, and weighed on a triple-beam balance, having a sensitivity of 0.01 gm. These samples were introduced into glass bottles of 125 ml capacity containing lake water of known pH and total alkalinity (average, 90 ppm, as  $\text{CaCO}_3$ ). Two bottles, blackened to exclude light, were treated similarly to provide an estimate of respiration during the test period (0.5-1.0 hr). The bottles were suspended at one-half meter intervals between 0-3 meters, to subject them to a variety of natural light intensities. Experiments were always performed at about 1:00 P.M. when light was near its maximum intensity for the day. Tests were also made on cloudy days, so surface light intensities varied considerably from one test to another. At the end of the test period the pH of the water in each bottle was determined using a Beckman pH meter. The micromoles of  $\text{CO}_2$  absorbed per gm of algae per hr was estimated by reading from a graph relating pH change to  $\text{CO}_2$  change (Verduin, 1951, fig. 1.) In the experiments described below final pH values higher than 9.5 were avoided because the lake pH seldom rises above 9.0, so higher experimental values would represent an unnecessary departure from natural conditions.

Light intensities were measured at the depth of each bottle, using a Weston photonic cell enclosed in a water-tight case.

Temperature measurements were made during each experiment using an ordinary mercury thermometer, calibrated in tenths of a degree C.

Estimates of ash-free dry weight of samples were made by drying in an oven, weighing, igniting in a furnace, and reweighing. For these weights a chainomatic balance was used.

## RESULTS

A wide range of variability was observed among tests carried out on different days. Figure 1 shows the results of 5 tests made between February 14 and 28, 1951, using samples from the *Ulothrix* community. The photosynthetic rates are graphed against  $\mu$ amps of current generated by the photonic cell. The rates were calculated using the original pH of the water in the bottles, rather than the

<sup>1</sup>Mrs. Theodore Ripper, Coraopolis, Pennsylvania.

final pH in the black bottles, as zero point. Thus the points below the zero line represent conditions under which respiration exceeded photosynthesis, and the points on the ordinate represent respiration rates in the black bottles. This figure shows a rather wide scatter of data points, but it is significant that the scatter is not purely random i.e., the points for any single test lie on a fairly smooth curve. The relative position of the curve with respect to the ordinate is the most variable feature, and is primarily caused by variable respiration rates observed from day to day. The causes of the day to day variation have not been studied. Similar variation was observed in *Cladophora* samples; consequently a single test does not represent a very good estimate of the average photosynthetic rate under natural conditions, but the mean of several tests provides a more reliable estimate.

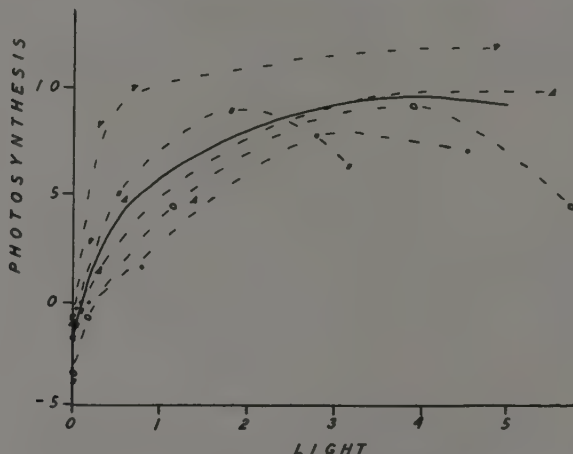


FIGURE 1. Apparent photosynthesis ( $\mu$ moles  $\text{CO}_2$  absorbed per gm wet wt per hr) of a *Ulothrix* community, graphed against light intensity ( $\mu$ amps Weston photronic cell,  $\times 10^{-3}$ ). The broken lines indicate separate experiments carried out between February 14 and 28, 1951. The solid line represents the average of the five tests shown.

Figure 1 also shows that inhibition of photosynthesis was frequently observed in the surface bottles, but that such inhibition was not associated with a particular intensity of light, but rather with the surface position of the bottle. Thus on February 23 inhibition was observed at a light intensity of only 3200  $\mu$ amps, although this same, and higher, light intensities, when encountered at a depth of one-half meter on other days, promoted maximal photosynthetic activity. This phenomenon was observed in other tests not shown in figure 1. It suggests that some quality of surface light, rather than its intensity, is responsible for such inhibition. It may be that certain wave-lengths, rapidly absorbed by water layers, are responsible. Tests with *Cladophora* samples never showed reduced rates at the surface.

The solid line in figure 1 represents the mean obtained from the 5 tests shown. The average respiratory rate amounted to about 20% of the total photosynthetic rate at optimal light intensity. The compensation point was reached, on the average, at a light intensity of about 100  $\mu$ amps. In the data presented below all curves are means of several tests made on different days.

Figure 2 shows four curves: two for *Cladophora*, one obtained during the Autumn of 1950, the other during the Spring of 1951; two for *Ulothrix*, one obtained during February and March, one during April, 1951. The shape of these curves reflects the adaptation of these littoral communities to bright light intensity; they show a relatively low efficiency at dim light intensities. The *Ulothrix* communities, however, showed higher relative efficiency at dim light than did *Cladophora*. For example, in figure 2, *Ulothrix* absorbed one-third as much  $\text{CO}_2$  at 500  $\mu\text{amps}$  as at 4000. *Cladophora* used only one-fourth as much  $\text{CO}_2$  at 500  $\mu\text{amps}$  as at 4000. This characteristic probably represents an adaptation by *Ulothrix* to the dimmer light of the winter months.

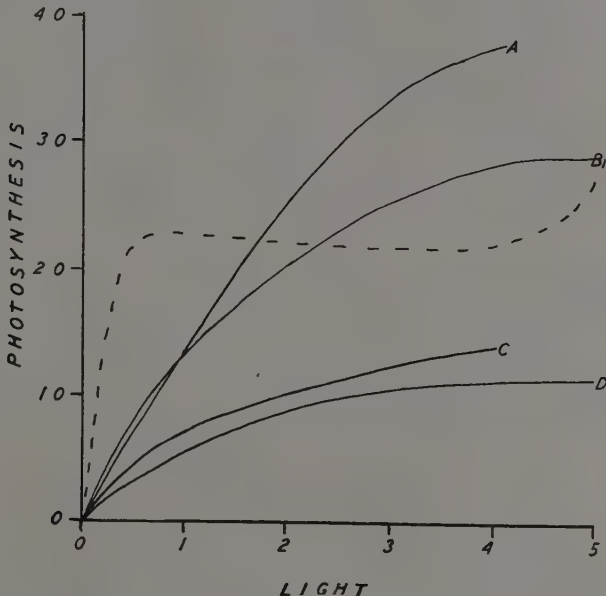


FIGURE 2. Comparison of photosynthesis ( $\mu\text{moles CO}_2$  absorbed per gm wet wt per hr) vs. light ( $\mu\text{amps Weston} \times 10^{-3}$ ) curves in *Cladophora* and *Ulothrix* communities. A = *Cladophora*, Autumn, 1950. B = *Cladophora*, Spring, 1951. C = *Ulothrix*, April, 1951. D = *Ulothrix*, January-March, 1951. The broken line represents the curve published by Manning et al. for a species of *Cladophora*.

Manning, Juday and Wolf (1938) have published a graph of photosynthesis v. light intensity for an unidentified species of *Cladophora*, showing data from a single experiment. The relative curve shape obtained by them is indicated by the broken line in figure 2. It differs radically from the curves of the present report, although their samples also were collected from an intensely illuminated habitat in shallow water. Plants showing such a curve would thrive at much dimmer light than would the littoral community of Lake Erie. No abrupt increase in photosynthesis in the region of maximal light intensity was ever observed in the Lake Erie material.

Since the photosynthetic rates appearing in figure 2 are based on similar quantities of plant matter, a comparison of the absolute rates exhibited by the different communities may be significant. The most obvious environmental difference

between the communities is that of water temperature. The mean temperature for the autumn tests of *Cladophora* was 18° C. for the spring tests 16°. The mean temperature for the winter tests of *Ulothrix* was 2°, for the April tests 7°. Since photosynthesis under optimal light shows a temperature coefficient of approximately 2 in laboratory experiments (Meyer and Anderson, 1952, p 355) it is interesting to test the hypothesis that the same relationship controls the photosynthetic rates, at optimal light intensity, of two different communities occupying identical space habitats but subjected to different environmental temperatures.

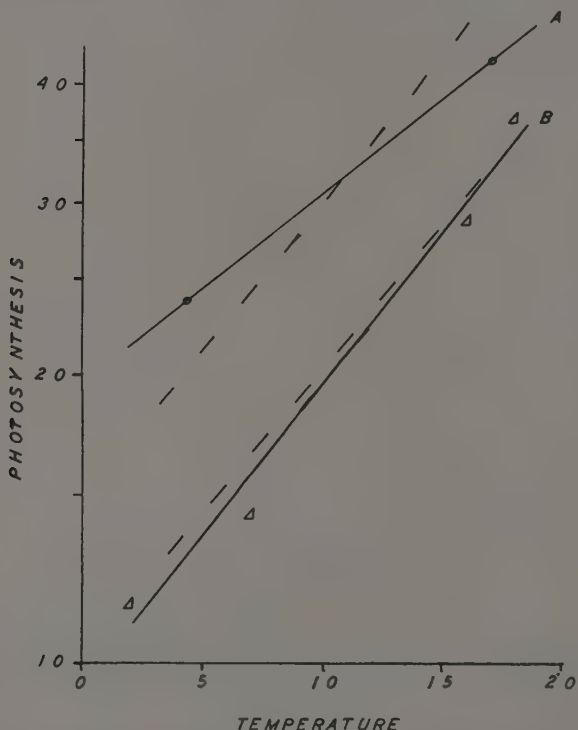


FIGURE 3. The temperature coefficient of photosynthesis at optimal light in natural communities. Temperatures below 10° represent *Ulothrix*, above 15° represent *Cladophora*. The broken lines indicate the slope required for a  $Q_{10}$  of 2. A =  $\mu$ moles  $\text{CO}_2$  absorbed per gm ash-free dry wt per hr,  $\times 10^{-1}$ . Observed  $Q_{10}$  about 1.7. B =  $\mu$ moles  $\text{CO}_2$  absorbed per gm wet wt per hr. Observed  $Q_{10}$  about 2.1.

The hypothesis is tested in figure 3. Here the photosynthetic rates shown at 4000  $\mu$ amps in figure 2 are plotted (logarithmic ordinate) against temperature in degrees C (linear scale). The solid line (B) was drawn, by inspection, through the data points. The broken line represents the slope required for a  $Q_{10}$  of 2. It is evident that the points lie reasonably close to a straight line whose slope indicates a temperature coefficient of approximately 2. The data were recalculated as photosynthetic rate per gm ash-free dry wt (line A). On this basis the apparent

$Q_{10}$  is approximately 1.7. Figure 3 shows that the differences observed between the photosynthetic rates of *Cladophora* and *Ulothrix* communities are largely explained by the difference in environmental temperature. It should be pointed out that the temperature coefficient of photosynthesis, as determined in laboratory experiments, refers to photosynthetic rates exhibited by a single species subjected to different temperatures, with all other factors supplied in abundance. It is noteworthy that the relationship seems to be approximately valid for different species studied under near-natural conditions at the temperatures of their natural environment. Moreover, the supplies of  $\text{CO}_2$  and other necessary materials, are probably not present in abundance in the natural environment, although they would be approximately the same for both communities in the experiments discussed above. This situation lends support to Baule's (1918) concept of limiting factors, which he has expressed in the form of a general equation (Verduin, 1953). Baule contends that all of the factors influencing a process are operative at all times, the degree of limitation being inversely, and exponentially, proportional to the relative abundance of each factor. Thus, although  $\text{CO}_2$  supplies in Lake Erie water are present in less than optimal concentrations, yet a powerful influence of the temperature factor is apparent. Furthermore, the curves in figure 2 remain separate in the region of suboptimal light intensity, suggesting that the temperature factor is still pronounced although both light and  $\text{CO}_2$  are supplied at suboptimal intensities.

#### SUMMARY

Photosynthesis studies of littoral *Cladophora* and *Ulothrix* communities under near-natural conditions showed rates at optimal light of 33  $\mu\text{moles CO}_2$  absorbed per gm (wet) hr for *Cladophora* at temperatures of about 17° C, and 12  $\mu\text{moles CO}_2$  for *Ulothrix* at about 4°. The photosynthesis vs. light curves showed relatively inefficient utilization of low light intensities, differing markedly from a curve for *Cladophora* in the literature. The temperature coefficient estimated from these data was approximately 2. The data seem to support the Baule-Mitscherlich theory of limiting factors.

#### LITERATURE CITED

- Baule, B. 1918. Zu Mitscherlich's Gesetz der physiologischen Beziehungen. Landw. Jahrb., 51: 363-385.  
Manning, W. M., C. Juday, and Michael Wolf. 1938. Photosynthesis of aquatic plants at different depths in Trout Lake, Wisconsin. Wisc. Acad. Sci., Arts and Lett., 31: 377-410.  
Meyer, B. S., and D. B. Anderson. 1952. Plant Physiology. 2nd ed. D. Van Nostrand Co., New York.  
Verduin, J. 1951. Photosynthesis in naturally reared aquatic communities. Plant Physiol., 26: 45-49.  
———. 1953. The Baule-Mitscherlich limiting factor equation. Science 117 (3041): 392.

---

**The Frogs, Toads and Salamanders of Eastern Canada.** E. B. S. Logier. Clarke, Irwin & Company, Ltd., Toronto. 1952. xii+127 pp. \$3.75.

An interesting and informative general account of the Amphibia, written in such a way that it appeals to both laymen and biologists alike. High lights of amphibian structure, life history, and special senses, along with a consideration of important factors limiting their occurrence and distribution add to the reader's feeling that the author knows well the animals about which he is writing.

A useful, functional key to the species of the region serves as a handy guide for identification of amphibians in the field. A glossary of terms adds further value to this book as a reference.

Recommended for libraries in summer camps, public schools, and colleges as well as for the library of amateur naturalists.

FRED H. GLENNY

# INDEX TO VOLUME LIII

- Acalles ohioensis*, n. sp., 118.  
 Acid mine waters, 123.  
 Alticinae, 51.  
 Andrews, Ted. F., 91.  
 Angerer, Clifford A., 240.  
 Annual report, Ohio Academy of Science, 244.  
 Anthribidae, 113.  
 Apid, Cabbage Root, 332.  
 Apodiformes, arteries near heart, 367.  
 Aquatic Animals, volumeter for respiration of, 240.  
 Arkle, Thomas, Jr., 1.  
 Arteries, near heart, Apodiformes, 367.  
 Arteries, near heart, Capimulgiformes, 356.  
 Arteries, near heart, Ciconiiformes, 347.  
 Aureomycin, effects of soft x-rays on, 363.  
 Bagley, C. T., 65.  
 Ballinger, Dwight G., 230.  
 Bat flea, 178.  
 Benzils, rearrangement of, 31.  
 Blanchard, Fred A., 363.  
 Blaydes, Glenn W., 193.  
 Blosser, R. H., 236.  
 Braconid genera, taxonomy and distribution, 173.  
 Bryson, R. A., 72, 221.  
 Calhoon, Thomas B., 240.  
 Calvert, Jack G., 293.  
 Caprimulgiformes, arteries near heart, 356.  
 Catalase, corn leaf, 101.  
 Cave survey, Ohio, 325.  
 Caves in the Lake Erie Islands, 358.  
 Cicada, periodical, 138.  
 Ciconiiformes, arteries near heart, 347.  
*Cladophora glomerata*, 373.  
 Cleveland harbor, industrial pollution, 14.  
 Clover root curculio, 105.  
 Conservation, water concepts, 168.  
 Corn leaf catalase, 101.  
 Curculionidae, 113.  
 Cyclops, variation in abundance, 91.  
 Davis, Charles C., 14.  
 Dehydrogenation of 3,4-disubstituted Thio-  
 lanes, 370.  
 DeLong, Dwight M., 77, 181, 226, 340, 349.  
 Diller, Violet M., 363.  
*Dikraneura ardea* n. sp., 350.  
*Dikraneura halberda* n. sp., 350.  
*Dikraneura*, new species, 349.  
*Dikraneura stonei* n. sp., 349.  
 Domesticated plants, the romance of, 193.  
 Early man in Eden Valley: A Review, 321.  
 Editor of Journal, change in, 219.  
 Edmunds, Lafe R., 121.  
*Erythroneura actualis*, n. sp., 83.  
*Erythroneura acericola*, n. sp., 88.  
*Erythroneura aesculella*, n. sp., 82.  
*Erythroneura ampasa*, n. sp., 86.  
 Erythroneura, biologic and taxonomic notes, 77.  
*Erythroneura comoides*, n. sp., 90.  
*Erythroneura emqu*, n. sp., 88.  
*Erythroneura everi*, n. sp., 88.  
*Erythroneura florida*, n. sp., 82.  
*Erythroneura frisoni*, n. sp., 80.  
*Erythroneura haspata*, n. sp., 85.  
*Erythroneura havana*, n. sp., 90.  
*Erythroneura imbricariae*, n. sp., 86.  
*Erythroneura juglandacea*, n. sp., 78.  
*Erythroneura lamucata*, n. sp., 88.  
*Erythroneura lyratae*, n. sp., 83.  
*Erythroneura noeoides*, n. sp., 83.  
*Erythroneura patris*, n. sp., 89.  
*Erythroneura phellos*, n. sp., 90.  
*Erythroneura rugosae*, n. sp., 80.  
*Erythroneura salmoides*, n. sp., 83.  
*Erythroneura similalis*, n. sp., 82.  
*Erythroneura lammina*, n. sp., 86.  
*Erythroneura tietzi*, n. sp., 85.  
*Erythroneura lura*, n. sp., 84.  
*Erythroneura ulmalatae*, n. sp., 80.  
*Erythroneura ulmosa*, n. sp., 78.  
*Erythroneura verdana*, n. sp., 81.  
*Erythroneura wysongi*, n. sp., 84.  
*Erythroneura zephyr*, n. sp., 84.  
 Evanidae, as household pests, roach control, 121.  
 Evans, Marna I., 37.  
*Exora californica* n. sp., 52.  
 Eyster, H. C., 101.  
 Fringe drift, Ohio, 183.  
 Galerucinae, 51.  
 Gaudin, Arden R., 230.  
 Geology, Switzerland Township, Monroe County, 1.  
 Glacial deposits, Cleveland, Ohio, 65.  
 Glenn, Fred, 347, 356, 367.  
 Harrold, L. L., 168.  
 Heating of air by solar energy, 272.  
 Heckweaelder's Toads, 217.  
 Herron, John C., 105.  
 Hocking River Valley, Pleistocene history, 143.  
 Holbrook, Robert L., 370.  
 Hymenopterous parasites of pine moths, 59.  
 Hynek, J. Allen, 314.  
 Indian places, how to locate on modern maps, 129.  
 Ingram, William M., 230.  
 Ippolito, Anthony L., 31.  
 James, Floyd L., 31.  
 Joseph, J. Mesheun, 123.  
*Joruma aurea* n. sp., 340.  
*Joruma clavata* n. sp., 340.

- Jourma krausi* n. sp., 342.  
*Jourma orizabae* n. sp., 342.  
*Jourma*, new species, 340.
- Kalm, Pehr, 138.  
 Kersten, H., 363.  
 Kosak, Alvin I., 370.  
 Knudsen, Lyle L., 351.
- Lake Mendota, currents in, 221.  
 Lake Mendota, Wisconsin, temperature variations, 72.  
 Lane, John E., 178.  
 Leafhoppers, Mexico, 181.  
 Leopard Frog, effects of chorionic gonadotropin on the testes of, 335.  
 Löf, George O. G., 272.  
*Lupercalia nitida* n. sp., 56.  
*Luzoniana philippina* n. sp., 47.
- McCourt, Robert P., 335.  
 McMillan, Gladys L., 373.
- MacNevin, William M., 257.  
 Mahr, August C., 129, 217.  
 Mead, Frank W., 327.  
 Merrill, William M., 143.  
 Metcalf, Z. P., 47.  
 Miller, William E., 59.  
*Monomacra opaca*, n. sp., 57.  
 Monroe County, Switzerland Township, Geology, 1.  
 Montane lakes, limnological study, Colorado, 159.  
 Mosquitoes, Ohio, An annotated list of, 327.  
*Myrmex algerii*, n. sp., 117.  
*Myrmex gillespiensis*, n. sp., 117.  
*Myrmex marshalli*, n. sp., 116.
- Nevens, Thomas D., 272.
- Ohio Academy of Science Annual Report, 244.  
 Olive, John R., 159.  
 Orchidaceae, Athens County, 179.
- Parallaxis diffusa* n. sp., 181.  
 Phenols, iodination of, 37.  
 Photochemical reactions, utilization of solar energy through, 293.  
 Photosynthesis, 280.  
 Photosynthesis of natural algal communities, 373.  
 Photovoltaic cells as power converter for solar energy, 300.  
 Pine moths, parasites, 59.  
*Polisanella aakeri*, n. sp., 50.  
 Pollution, Industrial, Cleveland harbor, 14.  
 Pollution, organic, relationship of *Sphaerium solidulum*, 230.  
 Porter, Walter P., 179.  
*Protalebra aureocosta* n. sp., 227.  
*Protalebra caldwelli* n. sp., 228.  
*Protalebra conica* n. sp., 228.  
*Protalebra*, Mexico, 226.  
*Protalebra pallida* n. sp., 228.  
*Protalebra plummeri* n. sp., 226.  
*Protalebra sobrina* n. sp., 228.  
*Protalebra variata* n. sp., 226.
- Rana pipiens*, 335.  
 Roaches, control by Evaniidae, 121.  
 Roney, Harland B., 14.  
 Rothmund, Paul, 280.  
*Rhyncolus stacesmithi*, n. sp., 119.  
 Ross, Herbert H., 77.  
 Ruppel, Robert F., 181, 226, 340, 349.
- Sharon conglomerate, artesian system in, 343.  
 Shaw, John H., 258.  
 Sleeper, Elbert L., 113.  
 Smith, Owen J., 173.  
 Smith, Philip M., 325.  
 Soil conservation, factors affecting economics of, 236.  
 Solar energy, heating of air, 272.  
 Solar energy, optical system in utilization of, 314.  
 Solar energy, photovoltaic cells as possible power converter for, 300.  
 Solar energy, the trapping of, symposium, 257.  
 Solar energy, utilization of through photochemical reactions, 293.  
 Solar radiation, 258.  
*Sphaerium solidulum*, relationships to organic pollution, 230.  
 Stansbury, David H., 358.  
*Stenocerus knullorum*, n. sp., 114.  
 Stout, Wilber, 183.  
 Stripmine reclamation research in Ohio, 351.  
 Struthers, Paul H., 351.  
 Suomi, V. C., 72, 221.  
 Surface water movement, Lake Erie, 42.  
 Sweet clover weevil, 105.  
 Switzerland Township, Monroe County, Geology, 1.  
 Symposium, the trapping of solar energy, 257.
- Tague, Glenn C., 343.  
 Taylor, Jay E., 37.  
 Temperature variation, Lake Mendota, 72.  
 Tettigellidae, two genera, 47.  
 Thiolanes, 3,4-disubstituted, attempted dehydrogenation of, 370.  
 Toads, John Heckewelder's, 217.  
*Triarius santarosarum*, s. sp., 51.  
 Trivich, Dan, 300.  
*Typhlocyba aureolineata*, n. sp., 182.  
*Typhlocybella parva*, n. sp., 181.
- Ulothrix zonata*, 373.
- Verber, James L., 42, 72, 221, 358.  
 Verduin, Jacob., 373.  
 Venard, Carl E., 327.  
 Volumeter for respiration of aquatic animals, 240.
- Water concepts, conservation, 168.  
 Water movement, surface, Lake Erie, 42.  
 Wene, George P., 332.  
 White, A. N., 332.  
 White, Sidney E., 321.  
 Wilcox, John A., 51.  
 Wisconsin, Currents in Lake Mendota, 221.

## R. H. BURTON COMPANY

can fill your optical needs



### BAUSCH & LOMB MICROSCOPES

Franchised Dealer

### MICROSCOPE REPAIRING

. . . All Types

Authorized by American Optical Company

### BINOCULAR REPAIRING

. . . All Makes

Authorized by Leading Manufacturers

### BINOCULARS FOR SALE

AUTHORIZED DEALERS

D. P. BUSHNELL

and

BAUSCH & LOMB

Pick-up and Delivery Service

## R. H. BURTON COMPANY

2504 Sullivant Avenue

COLUMBUS, OHIO

RAndolph 5472

CONSULT OUR

# Advertisers



PATRONIZE OUR

# Advertisers



MENTION

THE

# OHIO JOURNAL of SCIENCE

## *Now Ready . . .*

### A History of Entomology

By HERBERT OSBORN

A brief History of Entomology from ancient times down to the present day. Dr. Osborn, dean of entomologists, puts in type a most interesting story of entomology through all its various divisions. 255 photographs with sketches of many of the prominent entomologists of all time.

A book for the amateur, the teacher, the student.

*\$4.50 postpaid*

## THE SPAHR & GLENN CO.

FIFTY EAST BROAD STREET, COLUMBUS 15, OHIO